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The Engineer.

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VOL. CXLIII.—No. 3725] LONDON: FRIDAY EVENING, JUNE 3, 1927 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Assistant Engineer REQUIRED by the GOVERNMENT of the GOLD COAST for a tour of 12 to 18 months' service, with possible extension. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages, liberal leave on full salary. Candidates, aged 28 to 35, must have been trained as Civil Engineers and have a thorough knowledge of Surveying, and have had experience in Town Planning and Housing Schemes. Should be students or Associate Members of the Institution of Civil Engineers or possess equivalent professional qualifications.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/15357. 5636

Assistant Engineers (13) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no absolute guarantee can be given. If at the end of four years' service, an officer's services have been entirely satisfactory and he is not offered or declines further employment he will be paid a bonus of Dols. 2850. Salary Dols. 400 a month, rising to Dols. 800 by annual increments of Dols. 25, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No Income Tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering degree or obtained such other diploma or distinction in Engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer. Apply at once by letter, giving brief details of qualifications and experience, and stating age, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15,224. 5 539

Air Ministry.
DIRECTORATE OF TECHNICAL DEVELOPMENT.
JUNIOR TECHNICAL OFFICER is REQUIRED for the Air Ministry Technical Development Staff, primarily for duty at the Royal Aircraft Establishment, to assist in development work in connection with aeronautical instruments and small precision apparatus, with special reference to problems relating to high altitude flying.
Candidates should have an Honours Degree in Physics or Engineering, and some works and drawing-office experience would be an additional recommendation. Candidates must also be medically fit for high-altitude flying and willing to fly as observer.
Preference given, other things being equal, to ex-Service men. Salary £175, rising by annual increments of £15 to £235 per annum, plus Civil Service bonus, giving a present total starting remuneration of £278 10s. per year.
Application should be made on a form to be obtained from the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it must be returned, quoting reference No. A. 158, not later than 25th June, 1927. 5614

Armstrong College,
NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
5089 Newcastle-upon-Tyne.

Administrative County of LONDON.
The London County Council will REQUIRE in September next at the L.C.C. School of Building, Ferndale-road, Brixton, S.W., a VISITING LECTURER on STRUCTURAL DESIGN for one evening weekly.
Experience in the design and erection of Concrete and Steel Structures essential.
Fee 22s. for an attendance of about three hours.
Preference given to those who served or attempted to serve with H.M. Forces.
Apply, the Education Officer (T.1.a), The County Hall, Westminster Bridge, S.E. 1 (stamped addressed foolscap envelope necessary), for form to be returned by 15th June, 1927.
Canvassing disqualifies.
MONTAGU H. COX,
5611 Clerk of the London County Council.

The Engineer

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PUBLIC NOTICES

Crystal Palace School of Practical Engineering.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 5189

Manchester Municipal College of Technology.
Principal:
B. MOUAT JONES, D.S.O., M.A. (Oxon).
UNIVERSITY OF MANCHESTER
(FACULTY OF TECHNOLOGY).
DEGREE COURSES IN TECHNOLOGY.
The Prospectus gives particulars of the courses leading to the Manchester University Degrees (B.Sc. Tech., M.Sc. Tech., and Ph.D.) in the Faculty of Technology, in the following Departments:—
MECHANICAL ENGINEERING (Prof. Dempster Smith, M.B.E., M.Sc. Tech.).
ELECTRICAL ENGINEERING (Prof. Miles Walker, M.A., D.Sc.).
MUNICIPAL AND SANITARY ENGINEERING (G. S. Coleman, D.Sc.).
CHEMICAL TECHNOLOGY — including General Chemical Technology, Chemistry of Textiles (Bleaching, Dyeing, Printing and Finishing), Paper Manufacture, Metallurgy and Assaying, Chemical Technology of Brewing, Electro-Chemistry, Photography, Colouring Matters, Foodstuffs and Fuels (Prof. F. L. Pyman, D.Sc., F.R.S.).
TEXTILE TECHNOLOGY (Prof. W. E. Morton, M.Sc. Tech.).
INDUSTRIAL ADMINISTRATION (Post Graduate Course) (J. A. Bowie, M.A., D.Litt.).
Prospectus will be forwarded free on application to the REGISTRAR, College of Technology, Manchester. 5619

City and Guilds (Engineering) COLLEGE
(IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY).
There is a VACANCY for a DEMONSTRATOR in the Department of Mechanical Engineering and Motive Power. Practical experience and an Honours Degree of a British University or an equivalent academic qualification necessary. Salary £300 per annum, with the usual arrangement for membership of the Universities Federated Superannuation System.
Apply to Professor W. E. DALBY, F.R.S., City and Guilds (Engineering) College, Exhibition-road, London, S.W.7. 5607

PUBLIC NOTICES

Battersea Polytechnic.
LONDON, S.W. 11.
The Governing Body invite APPLICATIONS for the POSITION of PRINCIPAL of the POLYTECHNIC, owing to the resignation of Dr. R. H. Pickard, F.R.S., upon appointment as Director of the British Cotton Industry Research Association.
Salary, £1250-£50-£1500.
Applications to be made not later than June 13th.
Full particulars obtainable on application to the CLERK TO THE GOVERNING BODY. 5516

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for:—
2 SPANS, GIRDER BRIDGES (200ft. Through Span).
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 30th May, 1927.
A fee of 20s. will be charged for the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Thursday, 16th June, 1927.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS,
Secretary.
20th May, 1927. 5621

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for:—
(1) 5 PETROL TANK WAGONS (4-WHEELED) (I.R.C.A. STANDARD TYPE K.1), with WHEELS and AXLES, BROAD GAUGE.
(2) 50,000 BEARING PLATES for N.S. 50 lb. F.F. RAILS (Approx. 110 Tons);
100,000 BEARING PLATES for 41½ lb. F.F. RAILS (Approx. 205 Tons), METRE GAUGE.
Tenders are due in on Tuesday, 21st June, 1927, by 2 p.m. Tender forms obtainable at above address; fee One Guinea each, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender. 5623

PUBLIC NOTICES

Grangegorman Mental Hospital.
COLD STORAGE INSTALLATION.
The Joint Committee of Management invite TENDERS for a COLD STORAGE INSTALLATION in the meat room of Grangegorman Mental Hospital, capable of holding 16 quarters of beef and 4 sides of mutton, with a separate space or cabinet for 6 milk churns each 22in. diameter, and also an ICE-MAKING PLANT capable of producing 4 stone of ice daily. The plant must be capable of producing in the cold chamber or chambers a temperature of 36 degrees Fahrenheit within —— hours after the door has been closed.
It is essential that intending contractors shall visit the Institution and inspect the meat room and adjoining premises which can be made available for housing the refrigerating plant.
All building work (including foundations for machinery), except the fixing of insulating material, will be carried out by the Joint Committee's staff to the contractor's plans and specifications (which must accompany Tender), but the contractor must supply and fix in position the insulating material and all electric and refrigerating machinery with necessary connections.
The principal cold chamber must be provided with rails and roller hooks similar to those already existing in meat room to enable meat to be easily conveyed to and from meat room.
Contractors will be allowed to Tender for their own systems, and must furnish full particulars of same and state results to be achieved.
Each firm tendering must state the maximum time required for the completion of the contract. The Joint Committee in allocating the contract will be largely influenced by the time required for its execution.
Payment of 80 per cent. of the contract sum will be made on the certificate of the Resident Medical Superintendent that the work has been completed to his satisfaction and has fulfilled the required conditions. The balance will be retained for a period of six months, during which the contractor shall be responsible for the maintenance of the plant and installation.
The contract must be executed entirely by trades union labour.
Sealed Tenders, endorsed "Tender for Cold Storage Plant," will be received up to, but not later than, Twelve o'clock Noon, Wednesday, June 15th, for submission to the Joint Committee that day.
JAMES J. DOYLE,
Chief Clerk and Accountant.
Grangegorman Mental Hospital, Dublin,
May 24th, 1927. 5608

Stepney Borough Council.
ELECTRICITY SUPPLY.
A.—BOILERS AND BOILER-HOUSE ACCESSORIES.
B.—TURBO-ALTERNATOR, CONDENSER, ACCESSORIES AND SWITCHGEAR.
The Stepney Borough Council invite TENDERS from responsible contractors for the CARRYING OUT of the following WORK at the Council's Limehouse Station, viz.:—
(A) The Manufacture, Supply and Erection complete of Three Water-tube Boilers, together with Chimneys, Economisers and/or Air Heaters, and other Accessories.
(B) The Manufacture, Supply and Erection of One 20,000 K.W. Turbo-alternator, with Condenser, Accessories and Switchgear.
Copies of the general conditions, specifications, forms of Tender and drawings may be obtained from Mr. Wm. C. P. Tapper, M.I.E.E., Borough Electrical Engineer and Manager, No. 27, Osborn-street, Whitechapel, E. 1, upon receipt of a deposit of Ten Guineas for each section. Deposits will be returned to bona fide tenderers after the Tenders have been considered by the Council. Additional copies, with drawings, may be obtained upon payment of the sum of One Guinea each, which will be returned on receipt by the Council of such additional copies and drawings. Copies of the specifications and drawings may be inspected at the above-mentioned address by appointment.
Contractors will be required at all times during the existence of their contracts to pay the trade union rates of wages and observe the trade union conditions as agreed to by the Employers' Associations and Trade Unions, and as in practice obtain in connection with all work executed by the contractor whether carried out for the Council or others, and when carrying out any work under the contract on site, only men who hold trade union cards shall be employed.
Contractors will also be prohibited from assigning or underletting their contracts without the written consent of the Council previously obtained.
Tenders, on the form supplied, endorsed "Tender for Section 'A' or Section 'B,' as the case may be, must be delivered, signed, sealed and addressed to the Chairman of the Electricity Supply Committee, at No. 27, Osborn-street, Whitechapel, E. 1, not later than Noon on Monday, July 11th, 1927.
The Council do not bind themselves to accept the lowest or any Tender.
W. L. McCARTY,
Town Clerk.
Municipal Offices,
Raine-street, Old Gravel-lane, E. 1. 5606

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PUBLIC NOTICES

Ilminster Urban District Council.
ILMINSTER WATERWORKS.
CONTRACT No. 3.

TENDERS are INVITED for the CONSTRUCTION of INTAKE WORKS at Cudworth and COVERED SERVICE RESERVOIR, and about 6¼ Miles of 6in., 5in., 4in., 3in. and 2in. MAINS, for the Urban District of Ilminster.

Plans and specification can be seen at the office of the Engineers, Messrs. A. P. I. Cotterell and Son, Chartered Civil Engineers, 54, Victoria-street, Westminster, or of the undersigned, between the hours of 10 a.m. and 5 p.m., on and after 3rd June. Copies of the specification, bills of quantities and form of Tender may be obtained from the Engineers by intending contractors on payment of the sum of Five Guineas, which will be returned on receipt of a bona fide Tender and all other documents supplied.

Tenders, on the form provided, enclosed in sealed envelopes, must be delivered to the undersigned, and endorsed "Ilminster Waterworks, Contract No. 3," not later than 10 a.m. on Monday, June 20th.

Contractors will be required to provide securities for the performance of the contract under Section 174 (4) of the Public Health Act, 1875.

The Council do not bind themselves to accept the lowest or any Tender, and no Tender will be accepted, other than provisionally, until the sanction of the Ministry of Health has been received to the required loan.

J. DUKE,
Clerk.

Council Offices,
Ilminster, Somerset,
May 31st, 1927. 5627

Limerick Harbour Commissioners.
LIMERICK HARBOUR.
CONSTRUCTION OF NEW DOCK.

The Limerick Harbour Commissioners invite TENDERS for the CONSTRUCTION of a NEW DOCK at Limerick, comprising about 9¾ acres in extent, including Excavation, Dock Walls, New Entrance and Dock Gates, Entrance Jetties, Dredging and other Works, as provided for in the plans, specification and conditions of contract, which may be inspected at the office of Mr. T. F. O'Sullivan, B.E., Harbour Engineer, Limerick, or the office of the Consulting Engineer, Mr. P. H. McCarthy, M.A., B.A.I., M. Inst. C.E.I., 29, Lower Leeson-street, Dublin, during the usual office hours.

Forms of Tender, conditions of contract, specification, and schedule of quantities may be obtained from the undersigned on payment of a deposit of £20, which will be returned on receipt of a bona fide Tender, together with all the aforesaid documents.

Tenders, enclosed in sealed envelopes, addressed to the undersigned and marked "Tender for New Dock," must be delivered at the offices of the Commissioners not later than Ten o'clock a.m. on 20th day of July, 1927.

The Commissioners do not bind themselves to accept the lowest or any Tender nor will the Commissioners be responsible for any expenses incurred by persons tendering.

JOHN F. POWER,
Secretary,
Limerick Harbour Commissioners.

Limerick Harbour Commissioners' Office,
Limerick. 5492

Metropolitan Asylums Board.
OPENING OUT AND REPAIR OF THE ENGINES AND PADDLE WHEELS OF THE R.A.S. "GENEVA CROSS."

The Board invite TENDERS for the OPENING OUT, REPAIR and CLOSING UP of the ENGINES and PADDLE WHEELS of the River Ambulance Steamer "Geneva Cross," now lying at South Wharf, Rotherhithe, S.E. 16.

Specification, conditions of contract and form of Tender may be obtained at the office of the Board, Victoria Embankment, London, E.C. 4.

Tenders, addressed as noted on the form of Tender, must be delivered at the office of the Board not later than 10 a.m. on Wednesday, 15th June, 1927.

ALLAN POWELL,
5598 Clerk to the Board.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

A FIRST-CLASS PRODUCTION ENGINEER, with successful record as Works Organiser for maximum output at lowest costs, REQUIRED by well-known British engineering firm. Full particulars of training, experience, age and salary required.—Address, 5629, The Engineer Office. 5629 A

A FIRST-CLASS Successful DESIGNER of Air and Gas Compressors, Steam and Oil Engines and Steam Turbines, REQUIRED by a well-known North British firm. Send full details of training, experience, age and salary expected.—Address, 5628, The Engineer Office. 5628 A

ASSISTANT COMMERCIAL REPRESENTATIVE REQUIRED for London Office; age about 25, good theoretical and practical experience in Engines and Boilers essential.—Address, with full particulars, age, experience, salary required, GALLOWAYS, Ltd., Dept. C, Knott Mill, Manchester. 5600 A

ENERGETIC MACHINE TOOL SALESMAN REQUIRED. Applicant must have practical and sales experience.—Address, 5634, The Engineer Office. 5634 A

INSPECTORS.—SEVERAL are REQUIRED for Aero-engine Inspection. Must be capable of examining and reporting on same when stripped down after running tests. Applicants must have had similar experience and be prepared to qualify after training for a Ground Engineer's Certificate.—Address, stating full details of engineering experience, 5635, The Engineer Office. 5635 A

PROGRESS MAN REQUIRED for Large Engineering Works, London district; must be fully experienced in Machine Shop Progress Work and able to Take Charge of Section if required.—Address, stating age, experience, and salary required, 5524, The Engineer Office. 5524 A

REPRESENTATIVE of High Standing in Midland Counties REQUIRED by old-established manufacturers of Haulage, Winding and Guide Ropes for Mining, Specialists in Flattened Strand and Locked Coil Constructions; adequate salary and commission to suitable representative. Replies, giving all particulars, will be treated in strict confidence, and must be typewritten.—Address, 5631, The Engineer Office. 5631 A

REQUIRED for Abroad MECHANICAL ENGINEER, single, age 25-30, apprenticeship 5 years' completed imperative, also 2-3 years' experience preferably abroad, salary £500—3 years.—Apply, stating qualifications, age, &c., to Box 614, The E.C. Advertising Co., Ltd., 54, Old Broad-street, London, E.C.2. P3249 A

REQUIRED, WORKS MANAGER for Motor Works. Must be thoroughly experienced and capable of working in co-operation with Drawing-office on new design of engine. To a man of the right type an excellent salary will be paid.—Write, age, full particulars of qualifications and experience, &c., S. E., 6, Bloomsbury-street, W.C. P3248 A

ROADMASTER REQUIRED for South America, 80 kiloms. of track; might suit young civil engineer.—Write, Box E. B., 95, Bishopsgate, E.C. 2. 5603 A

WORKS MANAGER, with General Engineering Experience, accustomed to repetition work. Strict disciplinarian.—Write, stating experience, age and salary expected, to Box P.V. 3163, Willing's, 30, King-street, W.C. 2. 5613 A

WANTED, a LOCOMOTIVE DRAUGHTSMAN. State age, experience, and salary required.—Apply, W. G. BAGNALL, Ltd., Castle Engine Works, Stafford. 5625 A

WANTED, an ASSISTANT DRAUGHTSMAN, able to work out designs from rough sketches. State salary required. S.W. district.—Box 6701, W. H. Smith and Son, Strand House, Portugal-street, W.C. 2. P3253 A

WANTED for North of England, Practical DRAUGHTSMAN, with experience in design of Blocks for Heavy and Light Press Work and design of Jigs.—Write, stating age and salary required, to Z.L. 374, care Deacon's Advertising Offices, Fenchurch-avenue, E.C. 3. 5573 A

WANTED IMMEDIATELY, a First-class DRAUGHTSMAN; Design of Heavy Machinery and Structural Steelwork; must have good experience and references; London area; temporary post. Good salary to good man.—Address, 5632, The Engineer Office. 5632 A

WANTED, SEVERAL First-class DRAUGHTSMEN for Mechanically Propelled Vehicle; some with knowledge of Transmission. State age, experience and salary expected.—VICKERS Ltd., River Don Works, Sheffield. 5612 A

DRAUGHTSMAN (Engineering) REQUIRED, Used to Preparation of Catalogues, Sketches, Diagrams, &c. State salary required.—Address, P3251, The Engineer Office. P3251 A

DRAUGHTSMAN, Experienced in Conveying Plant and Cranes, capable designer and accurate worker. London district. State age, experience, salary, and when available.—Address, P3276, The Engineer Office. P3276 A

DRAUGHTSMAN for North London. Quick Man, able to estimate.—Write fully, stating experience, salary, &c., to P3256, The Engineer Office. P3256 A

DRAUGHTSMAN REQUIRED, Experienced in the Design of Heavy Passenger-carrying Vehicles.—Apply by letter giving full particulars and experience, age and salary required, to DENNIS BROS., Ltd., Guildford. 5610 A

DRAUGHTSMEN REQUIRED, Large Constructional Steel Works, North-East Coast; must be good Detailers.—Address, stating age, experience, salary required, when at liberty, 5599, The Engineer Office. 5599 A

DRAUGHTSMAN WANTED by Lift Manufacturers in the Midlands. Mechanical and constructional experience desirable. Please reply, giving particulars of experience, age, and wages required.—Address, 5555, The Engineer Office. 5555 A

DRAUGHTSMAN WANTED.—Letters and Particulars to LISTER BROTHERS, Laundry Engineers, Nightingale Vale, Woolwich, S.E. 18. P3269 A

DRAUGHTSMEN, with Experience of Electric Jib Cranes and Handling Plant.—Apply, stating age, experience, wages, when free, CHIEF DRAUGHTSMAN, John M. Henderson and Co., Ltd., King's Works, Aberdeen. 5617 A

DRAUGHTSMAN, with First-class Experience in modern Steel and Iron Works Practice, WANTED for N.E. Coast.—Write, stating experience and salary required, to Box "L," Kidd's Agency, Middlesbrough. 5630 A

FIRST-CLASS MECHANICAL DRAUGHTSMAN REQUIRED, with sound technical training. Applicants must give details of experience and salary required.—Address, 5597, The Engineer Office. 5597 A

LAY-OUT DRAUGHTSMAN REQUIRED for Oil Engine Pipe Work, &c. State age, experience and salary required.—Box 916, Advertising Offices, 84, Queen Victoria-street, London, E.C. 4. 5605 A

REFRIGERATING ENGINEERS Have VACANCY for DRAUGHTSMAN versed in High-speed Enclosed Compressors (CO_2 and ammonia). State age, salary, fullest details as to experience. Good opening.—Address, P3265, The Engineer Office. P3265 A

TRACER, Male, for London Engineer's Office, quick and accurate; one with Typing Experience preferred, but not essential.—Address, P3277, The Engineer Office. P3277 A

WANTED, FOREMAN for Large Constructional Works; must be experienced in Pressings of all kinds of Steel Work, including Tank Plates. State experience and wage required.—Address, 5620, The Engineer Office. 5620 A

EXPERIENCED CONTRACTORS' FOREMAN WANTED AT ONCE for Bridge Contract abroad, capable of Taking Complete Charge of Erection, Maintenance and Operation of usual items of plant. Also WANTED, FOREMAN, accustomed to Cylinder Sinking and Concrete Work.—Address, stating experience, age, 5601, The Engineer Office. 5601 A

FOREMAN GRINDER REQUIRED in London; should have held a similar position previously and be accustomed to turning out work to a high degree of accuracy.—Address, stating age, details of experience, in date order, and salary required, 5523, The Engineer Office. 5523 A

WANTED, First-class FITTER who Understands Erection and Repair of Machinery, also used to Motor Car Repairs.—Address, giving references and stating salary required, 5538, The Engineer Office. 5538 A

LADY SHORTHAND TYPIST WANTED; Knowledge of Machine Tool Terms and Engineering Expressions preferred, but not essential. Also ONE REQUIRED with similar qualifications and thorough knowledge of German Language and Shorthand.—Apply in own handwriting, enclosing references, stating speed, when at liberty and salary required, HENRY PELS, 32, Osnaburgh-street, N.W. 1. P3266 A

SITUATIONS WANTED

ADVERTISER, with 18 Years' Experience in Machine and Fitting Shop Management, Foundry, Forge, and Drop Stamping, DESIRES APPOINTMENT as INSPECTOR of WORK on N.E. Coast. Marine Installation, steam reciprocating, Diesel or Turbine, water turbine or other hydro-electric plant. Conversant with Admiralty, War Office, and Commercial contracts.—Address, P3255, The Engineer Office. P3255 B

ENGINEER, FITTER, TURNER, MILLWRIGHT, 20 years' general experience, and 9 years' marine, 1st class B.O.T. certificate.—Address, P3247, The Engineer Office. P3247 B

ENGINEER (25), G. I. Mech. E., 5 Years' Works, 4½ years' D.O. experience in design of rotary, turbo and reciprocating compressors, good knowledge oil engines and steam turbines, DESIRES SITUATION in either branch.—Address, P3259, The Engineer Office. P3259 B

GENTLEMAN, Many Years' Eastern Experience, exceptional knowledge foreign markets for all classes engineering goods, large clientele, also experience head office and works administration, DESIRES APPOINTMENT as SALES or TRAVELLING DIRECTOR where his knowledge and experience could be utilised to best advantage. Only progressive firms considered.—Address, P3278, The Engineer Office. P3278 B

FOUNDRY MANAGER DESIRES APPOINTMENT in similar capacity; 27 years' practical experience in aluminium and non-ferrous work for motor trade and general engineering. Highest references.—Address, P3262, The Engineer Office. P3262 B

MECHANICAL ENGINEER, with Over Twenty years' experience steam plant, oil engines, compressors, &c., DESIRES REPRESENTATION or SELLING AGENCY of first-class firm; excellent connection South-West England and S. Wales.—Address, P3260, The Engineer Office. P3260 B

YOUNG ENGINEER (28) SEEKS APP. Ex Public school and tech. training shops, 3 years D.O., 2 years assist. eng. Excellent testimonials.—Address, "Z.M. 375," Deacon's, Fenchurch-avenue, E.C. 3. 5573 B

WORKS CHEMIST, with First-class Experience, testimonials, &c., is SEEKING POSITION with Engineering Firm.—Address, P3270, The Engineer Office. P3270 B

WORKS SUPERINTENDENT SEEKS SIT; 250 men, thoroughly practical, disciplinarian, good organiser, production on economic lines. London district.—Address, P3274, The Engineer Office. P3274 B

YOUNG ENGINEER (24) REQUIRES SITUATION, technical training, with 5 years' workshop experience; passed A.M.I. Mech. E. exam.—Address, P3275, The Engineer Office. P3275 B

DRAUGHTSMAN, Age 27, Experience 12 years, shop and D.O., jigs, press tools, fixtures, automatics and broach design; £200.—Address, P3263, The Engineer Office. P3263 B

ENGINEER DRAUGHTSMAN (36), Capable Man, 17 years shops and D.O., 2nd B.O.T. Certificate, excellent refs., WANTS RESPONSIBLE POST, Plant Engineer or official capacity, home or abroad.—Address, P3226, The Engineer Office. P3226 B

YOUNG MAN (28) SEEKS POS. in D.O. with Firm, eng. or otherwise. Exp. in D.O., tracing, mould loft, gen. survey, &c. Technical training, Kent County and National Certificates; eng. and shipbuilding ref.—Address, P3271, The Engineer Office. P3271 B

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
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For continuation of For Sale Advertisements see page 3.

A Seven-Day Journal

Large Oil Engines for Power Station Work

AN important order for two 12,000 B.H.P. oil engines has recently been placed with the M.A.N. Company, of Augsburg, by the Maerkische Electricitaetswerk, Berlin. Each engine will have ten double-acting cylinders, with a bore of 600 mm. and a stroke of 900 mm., and will be designed to give an output of 11,700 B.H.P. at a normal speed of 215 r.p.m. The engines will work on the airless injection principle, and will be the largest sets of this type yet constructed. The object of installing the oil engine driven generator sets is to meet peak loads in the evenings, and also the early morning load during the winter time. The sets will also serve as stand-by units in case of any possible interruption at the main steam station or on the distribution system. They will be installed in the Hennigsdorf sub-station, and the generators will be connected to the engines by means of clutches. During standing periods the generators are to remain connected to the system, and they will thus act as synchronous condensers for improving the load factor. As the generators will be connected to the various sub-stations, they will help to reduce the quantity of idle current, and thus improve the efficiency of the distributing network. The 10,000-kW oil engine driven generating set which was installed at the Neuhof power station at Hamburg nearly a year ago has, we learn, continued to operate with great success, which has largely influenced this new order. Considerable interest is being shown on the Continent in the building of large Diesel engines, and work on a 10,000 B.H.P. Carels-Worthington double-acting engine is shortly to be started at Carels' factory at Ghent.

The Ryan Transatlantic Monoplane.

ON Sunday evening, May 29th, Captain Charles Lindbergh crossed from the Continent to Croydon on the Ryan monoplane on which a week or so previously he had flown the 3600 miles between New York and Paris in 33½ hours. The machine, built by Ryan Airlines, of San Diego, is driven by a Wright "Whirlwind" air-cooled radial engine of 220 horse-power, and in its design is in several respects unorthodox. Externally its most noteworthy characteristic is to be found in the fact that in order to reduce head resistance, the nose end of the fuselage is swept up without a break from the engine to the leading edge of the wing. The pilot sits in a completely enclosed cabin beneath the wing, and has no forward vision except by way of two small side windows, which he can open, or by way of a small periscope with which the cockpit is fitted. The design is no doubt suitable for Transatlantic voyages, but is hardly to be recommended for ordinary purposes demanding a sharp look-out and unobstructed vision when landing. The machine is built of steel tubing, the joints being made by welds. This system of construction is not officially encouraged in this country, for it requires extremely good workmanship to prevent the distortion, if not the burning and weakening, of the thin steel material during the welding process. The machine has a span of about 50ft., and its total weight as it left New York was about 4750 lb.

The Retirement of Sir Charles Sanders.

AT the end of last month, May 31st, Sir Charles J. O. Sanders, K.B.E., retired from the secretaryship of the Shipbuilding Employers' Federation, with which body he has been closely identified since January, 1918. Sir Charles was born in Devonshire and studied at King's College, London. He entered the Civil Service in 1885 and served in the Marine Department of the Board of Trade until December, 1917. Shortly after the outbreak of war he was engaged in administrative work connected with the building and repairing of ships, and in collaboration with Sir Westcott Abell he furnished statistical and other information which led to definite programmes of ship replacement being undertaken by the Government. Later on Sir Charles was accepted alike by shipowners and shipbuilders as a voluntary arbitrator to arrange for the extra cost which had to be met by shipowners owing to increases in the cost of labour and materials. On the formation of the Ministry of Shipping in December, 1916, Lord Maclay, who was then the Shipping Controller, appointed Sir Charles as the Director of Shipbuilding Work in the new Ministry, and also an executive member of the Merchant Shipping Advisory Committee. In 1917, when a Shipbuilding Council was constituted in the new Admiralty Controller's Department, Sir Charles was made the joint secretary of that Council, and when in 1917 the late Viscount Pirrie was appointed Controller-General of Merchant Shipbuilding by the Government, Sir Charles Sanders became his assistant. In January, 1918, Sir Charles joined the Shipbuilding Employers' Federation as the chairman of its Conference and Works Board. He was subsequently made secretary, and on Thursday of last week, May 26th, he was entertained at dinner by the Federation to mark his retirement from that post at the end of the month. Sir Charles will be succeeded in office by Mr. John S. Boyd. Although he has relinquished office, Sir Charles Sanders will not entirely sever his connection with shipping, for he was recently appointed by the Board of Trade to act as the chairman of the new Load Line Committee.

The Hermitage Dam at Kingston, Jamaica

THE Hermitage Dam at Kingston, Jamaica, work on which was begun on December 1st, 1924, has recently been successfully completed by Sir W. G. Armstrong, Whitworth and Co., Ltd. It is situated 12¾ miles from Kingston, at a point 1688ft. above sea level, and impounds some 500,000,000 gallons of water with a surface area of close upon 37 acres. The water is drained from an area of approximately 6 square miles in extent above the dam. The dam has a length of 673ft., with a height to the crest of 142ft., and a thickness at the base varying from 30ft. to 100ft. Along the top of the dam is a reinforced concrete gangway giving access to the valve house and valve tower. It comprises thirty-one spans, each with an opening of 15ft. clear, giving a spillway along the crest of the dam 465ft. in length. The top of the dam is curved in such a way that the flood water rolls over it without shock. On the downstream side of the dam a spillway channel is provided to convey the flood water back to the river bed. The storage reservoir which the dam forms is intended to supply reserve water for Kingston and St. Andrews during periods of drought, and will also increase the ordinary water supply in that area. At the formal opening of the dam, which took place early last month, the Governor of Jamaica, Sir Reginald Stubbs, referred to the dam as being the most important engineering work which had yet been carried out in the Colony, and emphasised the great benefit which it would confer on the community.

The Hull Railway Accident Report.

IT must be a matter of satisfaction to British railway officers generally and to those of the London and North-Eastern in particular that, in his report on one of the six serious accidents of the last twelve years—that at Hull on February 14th, when twelve passengers were killed—Colonel Sir John Pringle, the Chief Inspecting Officer of Railways, has only one recommendation to make. Writing in this page of our issue of February 18th, before the cause was openly known, we said that one of three factors must have contributed to the disaster, and one we named was the premature replacement of a signal releasing the facing points ahead of the train, which points, if moved, would divert the outgoing train on to the path of the incoming. That, it is shown in Sir John's report, is exactly what happened. Before reciting the recommendation made by the Inspecting Officer we would say that he shows that there are reasons of safety which call for a modification of the strict interpretation of rule 61 (*b*) as to signals not being restored until the train has passed over the junction protected by such signal. Sir John also reports that "As a safeguard against similar occurrences, I am not in favour of additional signalling, nor do I think that intermediate electrical or mechanical clearance bars would be suitable, in view of light engine traffic." He then recommends what is technically known as approach locking, *i.e.*, a track circuit between the signal and the points, whereby any vehicle in advance of the signal will hold the points which the train is approaching, even although the signal be replaced.

Two New Canadian Pacific Liners.

THE announcement is made that Canadian Pacific Steamships, Ltd., has ordered two further "M" class passenger and cargo liners from John Brown and Co., Ltd., Clydebank. These new ships are in addition to the two liners ordered last year, one of which is now under construction at John Brown's Clydebank yard and the other at the Dalmuir yard of William Beardmore and Co., Ltd. The new liners will be generally similar to the ships which were placed in June last, which have a length of 585ft., a breadth of 75ft., with a measurement of about 18,000 tons at 27ft. draught. Accommodation will be arranged for 1600 passengers and hold capacity for about 4000 tons of cargo is to be provided. The propelling machinery will consist of Parsons turbines with single reduction gearing, and will be designed for a steam pressure of 350 lb. per square inch and a superheat of 250 deg. Steam will be raised in a combined installation of Yarrow water-tube and Scotch boilers. As the new liners are to be designed for a sea speed of 18 knots in the North Atlantic, or half a knot faster than the two vessels now under construction, the output of the propelling machinery will be proportionately greater. Electrically driven auxiliaries will be installed and the current required to drive them will be generated by a 500 kW oil engine and steam turbine-driven generators. John Brown and Co., Ltd., are to be congratulated on securing two such important ships. No doubt they will usefully fill the berths recently vacated by the two cruisers for the Royal Australian Navy, namely, the Australia and the Canberra. The last named vessel was launched at midday on Tuesday last, the naming ceremony being performed by Princess Mary, Viscountess Lascelles.

Argentine Naval Contract for Italy.

THE Orlando Shipbuilding Company, of Leghorn, has received from the Argentine Government a contract for two light cruisers. This is the largest naval order from South America which has been placed for many years. At least six British firms tendered for the work, but the fact that the four most powerful cruisers under the Argentine flag were built in Italy some thirty years ago and are still serviceable, may have secured favourable consideration for the Italian bid. The original specifications were for two cruisers of separate types, one of 6000 tons and 32 knots, the other of 5100 tons and the same speed. It has now been decided, however, to have both vessels built to uniform design, the leading particulars of which are as follows:—Length, 542ft.; breadth, 57ft. 10in.; displacement, 6200 metric tons; turbine machinery of 85,000 shaft horse-power for a speed of 32 knots. Both ships are due for delivery within twenty-four months. The keel of the first will be laid at Leghorn as soon as the slip is vacated by the Italian cruiser Trento, which is shortly to be launched. The second vessel is to be built at the Odero yard, Genoa, under licence from the Orlando firm. The cost of each is reported to be about £1,225,000. In March last, it will be recalled, J. I. Thornycroft and Co., Ltd., obtained an order for six large destroyers for the Chilean Navy, and Hawthorn, Leslie and Co., Ltd., have recently booked a contract for two tugs for the Argentine Navy. Other naval orders from South America are known to be impending, and hopes are entertained that British firms will secure a share of the work.

A Six-wheeled Omnibus for London.

THE London General Omnibus Company, Ltd., has recently submitted for test to the Scotland Yard traffic authorities a new six-wheeled double-decked omnibus, with a covered top, which, it is expected, will shortly be put into service on the London streets as an experimental unit. The new vehicle which has been entirely designed by British engineers was built at the new Southall factory of the Associated Daimler Company, Ltd. It will be known as the "London-Six," which name will be signified by the letters "L S" which appear on the bonnet covering the engine. The new bus has a seating capacity for sixty-eight persons, which is exactly double the number of persons carried by the first "B" type buses which were introduced in the year 1910. The engine for the new vehicle is a six-cylinder sleeve valve Daimler model, designed for an output of 60–120 horse-power, which is large when compared to the 28 horse-power engine of the "B" type bus. Pneumatic tires are fitted, which will be employed for the first time on a double-decked bus operating in London. There is no doubt that if the new design proves to be successful, as is confidently expected, then, owing to its largely increased seating capacity, the six-wheeled vehicle will be an important factor in solving the difficult problem of traffic congestion in the streets of the Metropolis.

An Electrical Exhibition in Italy.

ON Saturday, May 28th, the King of Italy opened an electrical exhibition at Como in commemoration of the centenary of the death of Alessandro Volta, the Italian scientist who invented the voltaic pile. The exhibits consist of wired and wireless telegraphy and telephony apparatus, which will remain on view until October, and during the course of the exhibition an international telegraph and telephone congress will be held. One of the most interesting contributions to the display of electrical devices has been made by Mr. Marconi, who has sent a valuable collection of apparatus, including that used in his earliest experiments, together with transmitting and receiving instruments which were employed in the early days of wireless communication, before the introduction of the thermionic valve. The Marconi Company is also exhibiting a collection of modern wireless apparatus, including the company's wireless automatic alarm device for use on ships, a complete wireless set specially designed for whalers, a short-wave beam receiver as used in the "Empiradio" stations, a short-wave military field station for communication with aircraft, and a selective receiver for duplex telephone working or for the reception of the transmission of broadcasting stations on board ship. Photographs also illustrate the evolution of wireless apparatus and wireless telegraph stations. The original instruments used by Volta were all, unfortunately, destroyed by fire on the morning of July 8th at the exhibition held at Como in 1899. Many reproductions of Volta relics will, however, be shown at the present exhibition, together with a collection of Volta's scientific writings and letters. In second week of September an International Congress of Physics will be held at Como.

Steam Shovel Work in Tropical South America.

By R. DESMOND FORRESTER.

AT an open-cast mine in tropical South America it was decided to extend the working face of the mine by making a cut 950ft. in length and 50ft. wide with a steam shovel. The portion of the mine in which the cut was made is shown in Fig. 1, the cut lying northwards from the point X. Up till the time that the decision was come to, the steam shovels had only been used for overburden stripping purposes, hand labour being employed to quarry the ore and to load it into railway trucks for transport. After careful consideration it was decided, as has been said, to bring one of the machines into use, not only for making the cut, but for replacing the hand labour employed in loading the ore after the cut had been made.

There were in use at that time three Bucyrus 18 B ¾-yard dipper steam shovels running on caterpillars and working backwards and forwards along the overburden stripping the latter to expose the ore. It was arranged that, while one machine should continue at

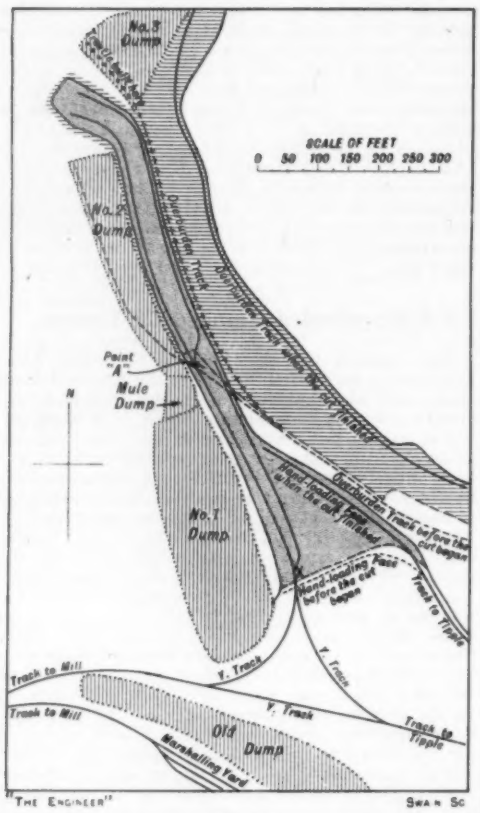


FIG. 1

its original task another should work on the overburden immediately above the proposed cut, while the third should be brought down to the mine floor level to carry out the proposed cut. It is mainly with the work of this third shovel that we are concerned in this article, for the new use to which it was brought formed an interesting experiment worthy of notice.

The first step in the experiment was to remove the shovel from the overburden level to the mine floor, and for that purpose a point was chosen where the ore face was 10ft. high, that being the lowest point practical in the face which then averaged 16ft. in height. Actually it was near the point marked X in Fig. 1.

To bring the machine from the higher to the lower level it was necessary to form a ramp in the ore face. How that was done is shown in Fig. 2. Three lines of holes, 10ft., 7ft., and 3ft. deep respectively, were drilled at 9ft. centres, as shown in the engraving. These holes were charged with explosives and when the shot was fired a wedge-shaped piece was successfully broken out of the body of ore. Down the slope so formed the shovel was "walked," casting the loose material in front and on either side of it until the caterpillar treads were on the mine floor level.

The overburden shovel started at once to work away the bank immediately above the cut, sending its material to the No. 2 dump—see Fig. 1—which is about 10ft. lower in height than the No. 1 dump.

When it was no longer possible to swing the track to connect to No. 2 dump at point A, the shovel proceeded to overcast on either side along the edge of the dump directly over the ore to be removed by the shovel cut below. The overburden along this line was proved by drilling to be of an average thickness of just under 3ft., and the ore was estimated at 19ft., but for calculations, allowing for spillage, an average of 18ft. was assumed. Within a week the shovel had overcast a track 40ft. wide and 450ft. long, into which the track from No. 2 dump was laid. The arrangements for dumping were then completed. A trestle was built to handle the overburden sent to this new dump, and the material was placed—after careful drilling—well clear of the ore body. The urgent need for speed with regard to the stripping is apparent when it is realised that, when the shovel began sending the ore down to the mill, special arrangements had to be made to treat the stone, because up to that time the hand loaders had been sending picked ore.

In addition to the ore cut, which, as has been said, was going to be made 50ft. wide, it was necessary, in order to allow for smooth running, to increase the area stripped by another 40ft. to permit the passage of 18-ton Porter locomotives and Western cars on a 3ft. gauge track and the mule carts carrying the secondary stripping to and fro between their work and their dumps. This stripping shovel, as soon as it had completed this overcast, was walked back opposite to point A, where it dug itself into the bank preparatory to making another cut. The overburden shovel did excellent work, as not only did it strip the way for the ore cut and the necessary ground to allow for the passage of mules and track between the mine face and the overburden bank, but it also laid bare a big area of ore which was available for mining as soon as the cut was finished. Except for a broken boom during the early stages of this work, the "ore shovel" ran smoothly throughout. The actual volume of material removed from the cut was 33,740 cubic yards, or equivalent to 50,000 green tons sent to the mill. In addition to this tonnage, must be added the ore removed in the preliminary grading and also the removal of some ore from the sides of the cut in the earlier days of the work.

All the locomotives used in the cut and on the overburden were 18-ton Porter's "Dinkies," and for the

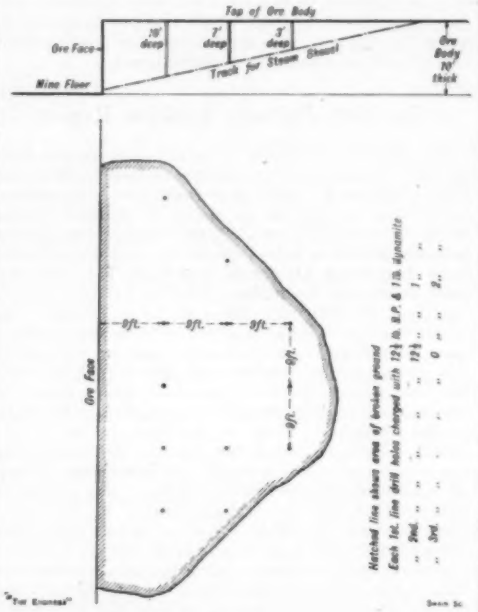


FIG. 2

purpose of this article they may be considered standard models, though they were far from being in their "first youth."

It should be mentioned here that as a result of taking levels and samples from the outside of the cut, it was found beneficial to remove some 4ft. of the mine floor, which proved to contain washable ore, and at the same time to reduce the gradient for the track which was to be laid into the cut from the main line sidings, where the cars were "marshalled" before leaving the mine for their 10-mile journey to the mill.

While the stripping was progressing the Y track—see Fig. 1—and connection to the cut were laid in 60 lb. to the yard rails, which weight of rail was laid throughout the work on the main line; but on the two switch lines 35 lb. per yard rail was put down, "crimped" fish-plates being inserted at the joints of different weights of rail.

When the track on the mine floor was sufficiently completed to start loading, the face was drilled and shot in the way which had given every satisfaction for hand loading. The method at first employed—to take an average case—was to drill holes 1¼in. in diameter, 9ft. apart, with churn drills from the top of the ore body, giving an average burden of 9ft. The system of drilling employed was for two men to raise and let fall hexagon steel ⅞in. drills, which were made in three lengths of 12ft., 16ft., and 20ft. respectively. Owing to the comparatively soft nature of the mineral being minded, it was found cheaper to adopt this method of drilling rather than the more usual and expensive methods, such as compressed air machines. The holes were "sprung" with 1 lb. of dynamite so as to form a cavity at the mine floor level, in which 50 lb. of black powder and 2 lb. of dynamite were placed. The holes were then stemmed with earth and fired electrically, about twenty holes being fired sumultaneously, No. 6 caps being used.

The attempt proved a failure, as large lumps were broken out that had to be placed behind the shovel, which caused endless delay. Many also found their way into the cars and choked the crushers at the mill, as they were unable to handle any lumps over 1ft. 3in. cubes. This looked like proving the shovel loading a failure, as the additional cost of breaking up the lumps by hand labour was so heavy. In addition to this trouble, the loading rate of the shovel was so slow that it was running far below the estimated output. The matter was brought to a head by the breaking off, at an old crack, of one of the dipper sticks through striking a large stone. After several experiments with different spacing and charging the following scheme was evolved and was adopted throughout the rest of the cut, since it worked with entire satisfaction. It necessitated the use of more explosive, but that was a welcome increase in the cost sheet, since, in exchange for it, there was a very considerable reduction—in some cases, in fact, elimination—of the other and more serious items. If some such system had not been evolved it is just possible that the steam shovel would never have made its way to the further end of the cut on account of high cost.

Holes were placed 6ft. apart and in rows at the same distance, but staggered. Every second row consisted of deep holes, to the bottom of the ore body, and the intermediate rows were 10ft. holes. Wing holes were also sunk if hard ore remained unbroken after the last shot. The deep holes were sprung with 2 lb. of dynamite and the shallow ones with 1 lb. At the bottom of the deep holes the cavities were filled with 50 lb. of black powder and 4 lb. of dynamite and one electric detonator. From there up to within 6ft. of the surface the holes were column-loaded with 6 lb. of dynamite. A strong wad or stemming was filled in to the top 6ft. Three detonators were used in these deep holes, one 13ft. and one 7ft. from the surface, in addition to the one in the cavity. The smaller or intermediate holes were filled with 25 lb. of black powder and 2 lb. of dynamite in the cavity, in addition to 2 lb. of dynamite in the hole between the cavity lip and 6ft. from the surface. Two detonators were used for these holes, one being placed in the cavity and the other 7ft. from the surface. The arrangement is illustrated in Figs. 3 and 4.

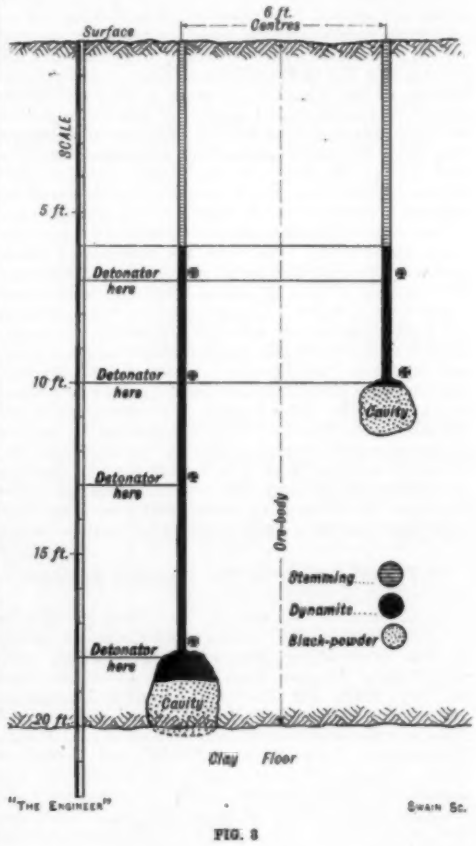


FIG. 3

Experiments were also tried as to the best number of holes to fire at one time, and it was found that about fifty holes made a good shot, but as many as eighty holes were tried during the preliminary stages of the work.

The following is an analysis of a typical blast by this method. Consideration must be given to the fact that this mine is very much further from the explosives factories than those in the United States of America, and so, naturally, the cost of explosives is very much more, as they have to be transshipped from the ocean-going steamers to punts, unloaded from the latter and carried to the magazine by hand. In addition to the high freight charges, the rate of deterioration of explosives is quicker in the tropics than in more temperate zones, and that results in a lower efficiency. At the same time, the difficulties of

QUARRYING OPERATIONS IN A SOUTH AMERICAN MINE

CONSTRUCTING TRESTLE ON CLEARED GROUND

BEGINNING OF NO. 3 DUMP

VIEW OF NO. 3 DUMP AFTER THREE MONTHS WORK

VIEW FROM NO. 2 DUMP LOOKING TOWARDS WATER TOWER

PORTER LOCOMOTIVE AND WESTERN 4-YARD DUMP CARS

STRIPPING OPERATIONS DURING RAINY WEATHER

STRIPPING OPERATIONS DURING RAINY WEATHER

THROWING THE OVERBURDEN TRACK

supply necessitate keeping up a large stock, the usual supply being 10 to 12 tons every three months.

Drilling and Blasting Analysis.

Total number of long holes	27
Total number of short holes	27
Total number of holes fired	54
Depth of long holes—18ft. × 27 ..	486ft.
Depth of short holes—10ft. × 27 ..	270ft.
Total feet drilled	756ft.

Springing.

27 holes at 2 lb. dynamite	54 lb.
27 holes at 1 lb. dynamite	27 lb.
Explosives in springing	81 lb.

Firing.

27 long holes containing 50 lb. black powder in each	1350 lb.
27 short holes containing 25 lb. black powder in each	675 lb.
Total quantity of black powder used in blast	2025 lb.
27 long holes containing 10 lb. dynamite each	270 lb.
27 short holes containing 4 lb. dynamite each	108 lb.
Total quantity of dynamite used in blast	378 lb.
Total quantity of dynamite used in "springing" = ...	81 lb.
Therefore total quantity used in all = ..	459 lb.
Total quantity of black powder and dynamite used in blast, 2025 lb. ÷ 459 lb. = ...	2484 lb.
Area of ground broken 50ft. wide by 18ft. deep by 36ft. long	32,400 cubic feet
Specific gravity of ore	2·45
Proved volume of ore, 18·5 cubic feet =	1 ton green ore in place
Therefore total quantity of ore broken by blast = ...	1750 tons

So that the ratio $\frac{\text{green ore}}{\text{explosives}} = \frac{1750\text{ (tons)}}{2480\text{ (lb.)}} = \frac{1}{1{\cdot}42}$

It is quite admitted that these figures do not compare favourably with the usual statistics for this type of work, but when all-round reduction of costs, both at the mine and at the mill, are taken into consideration, the excessive use of explosives per ton of ore mined proved to be a big benefit to the company in this particular case.

The operations were, fortunately, favoured by good weather. Until within two weeks of the completion of the cut hardly a drop of rain fell. When the end of the cut was within sight, however, the clouds were gathering and the wind changed and rain was evidently coming. Its approach caused some anxiety, since the ore body had taken a dip at the point reached in the cut and the drainage channel, which had been maintained throughout the cut, had been abandoned, as it had been impossible to keep the gradient to run the water out of the cut. The consequence was that the cut for about 200ft. formed a natural reservoir and the shovel was at the bottom of it.

Every available moment was used to increase the tonnage and so get the cut through. At this period a small spring was struck in the floor of the cut, which started to make the ground sticky. Then the rain came and things looked bad, as the cut was flooded and the rails covered. The pipe fitters and the fire department came to the rescue, and, aided by a few pounds of dynamite for sinking a sump and 400ft. of canvas fire hose, all was made ready for installing a pump. In the meantime the mine mechanic and his squad were busy at the pump station taking up one of two Cameron pumps which was ordinarily used for the water service, fitting it on a small 1½-yard car, and running a flexible armoured steam hose pipe from the safety valve of a locomotive to the pump. Both car and locomotive were run into place in the cut, the pipes coupled up and the pump started to work. It only took three hours to prepare this equipment, and after five hours' running it was again possible to work the shovel. The pump remained in position and, periodically, a locomotive would be run in to do a spell of pumping to keep the water below the rails. It may be remarked, in passing, as giving some idea of the work done by the Porter locomotives, that most of them were at work for 137 hours per week throughout. It was a great relief when the last blast was made and the shovel cleaned up the last few yards by overcasting to make a through drain.

When the cut was first started it was not possible, with end loading, to run a train of cars past the shovel, and therefore only a single track was laid up to the shovel, thus reducing the loading rate to below the anticipated figures for this work. But after the track was doubled and the outside Y track and other connections made the loading speed increased. Nevertheless, throughout the cut, which took eighty-eight days' actual work to put through, the output averaged 525 tons of green ore, equivalent to 160 four-yard Western cars per day. The shovel ran from 6 a.m. to 4 a.m. and stopped for cleaning for two hours.

As is always the case with end loading, the output varied according to the number of cars within reach of the dipper at one time. Immediately after a blast, when the ends of both tracks were covered with fallen ore, the record rate was eighteen cars per hour, being 54 tons per hour with three 18-ton "Porter" locomotives bringing up trains of six cars at a time. The dipper could reach three cars on either track, and, while one locomotive was changing cars, the shovel was loading ore into the train attached to the second. Before the first three cars of the second train were filled, the first locomotive had placed the three empty cars back into the end of the cut, and had removed the full cars out of the track of the other locomotive. Then as soon as the second locomotive had removed the three full cars from the track of the first locomotive, the line was clear for the six full cars to be taken back to the siding and exchanged for empties. While that was happening in the shovel cut, the third locomotive had collected six empties from the marshalling yard and was waiting at the Y track for the first locomotive to pass. It then took its place in the end of the cut.

Unfortunately, this did not last long, as the shovel soon advanced beyond the reach of the third car of each train, and was only loading "two" at a time on each track. As soon as that stage was reached, the shovel cleared enough ground to allow for an extension to be made to the rail track on one side and a 10ft. length of track was then added. While these extensions were being made it was only possible to load on one side. Thus the number of locomotives was reduced, and so, proportionately, the output of cars was lessened. When it was only possible to load one car at a time the shovel was sometimes stopped and the boiler sponged. When that happened, the men employed on secondary stripping were brought down to the mine face and the average output from the mine was maintained. During the eighty-eight days taken for the work many variations of the system were resorted to, with the two all-important ideas of keeping up the regular output and at the same time lengthening the cut. After the first few weeks it was

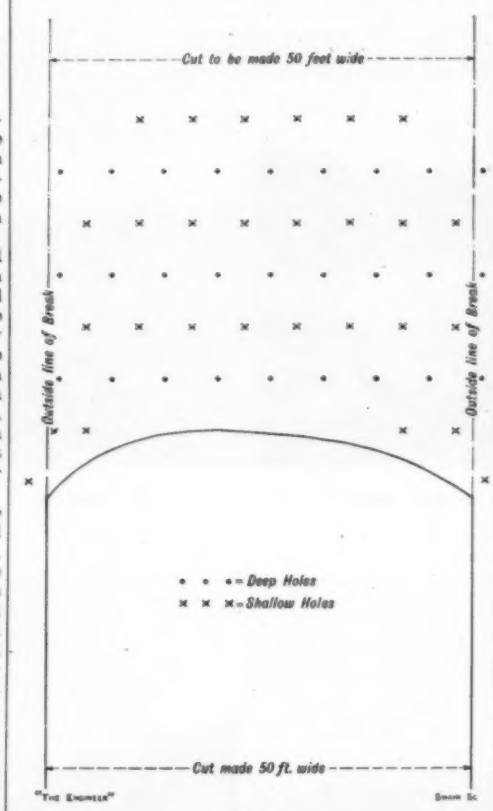

Cut to be made 50 feet wide
Outside line of Break
Outside line of Break
• • • = Deep Holes
× × × = Shallow Holes
Cut made 50 ft. wide
"The Engineer"

FIG. 4

easier to estimate the day's work. Extensions were made towards the end of the day and the cleaning and sponging of boilers and other details were brought nearer to schedule, so that, towards the end of the cut, ore was being produced almost as cheaply by this slower method of loading as was done by hand loading, or by shovel loading when a train of cars could be taken past the loading point and loaded in the normal way. In fact, the results of this cut were so satisfactory that when a new shovel arrived from the United States it was put to work at the opposite end of the mine and an output of over 300 cars per day was being produced by the two machines during daylight—12½ hours. As soon as the overburden had been stripped this "newer" shovel was going to cut its way round the south end of the ore body and so make a bigger face of ore available and produce the bigger output called for.

Although the plant was made up of units of similar horse-powers and capacities, its component parts were by no means all of the same pattern. One of the shovels, for example, was credited with having worked in the Panama Canal, whilst another, although a ¾-yard dipper Bucyrus, was made since the war for a firm in the United States. Four-yard dump cars were purchased in various parts of America, and their ages were often wrapped in mystery, so that any small improvement on the part of the makers during the past century was always brought rather forcibly home to the unfortunate mechanical staff. Still they made the plant do excellent work, for which there is much credit due.

It is not always just to blame the makers for every breakdown, for when it is realised that, during one year, a dozen natives mastered the mysteries of shovel operating—and some of them could handle as much material as the average operator in the United States and at the same time keep his shovel in running repair—there is no real cause for complaint. Locomotive drivers were turned out in any time between three weeks and a month after their first lesson.

The 4-yard Western cars took the ore from the mine to the mill. The 10-mile haul was done by Porter locomotives which were of a larger size than those used in the mine service, could handle as many as eighty-five 4-yard cars under full load. It was quite a usual occurrence for these cars to run as much as 50 miles per day and 300 miles per week, half of the time under full load. For a haul of this distance, 8-yard cars would have been more suitable, but, for the varying conditions and duties of the work, 4-yard cars were perhaps more useful.

Water for the shovels and locomotives was pumped into a 10,000-gallon tank which stood on the mine floor elevated about 15ft. higher than any part of the mine, so that it could feed all the plant by gravity. Three-inch diameter pipes carried the water to all points as far as the overburden, where the diameter was reduced first to 2½in. and then 2in. and a complete circuit round the working area was maintained. The arrangement proved a great success, as it was possible to do any repairs and extension work on the pipe line by shutting off one side of the supply and running the water round the other half of the circuit. In this way no delays were caused to the plant by the pipe fitters. T-pieces were put in at the important switch points for the locomotives. Along the edge of the shovel cut T-pieces were placed at an average distance of 200ft., and from them pipes of a reduced diameter were carried to the shovel, which was fed by 1in. armoured hose through the main vertical shaft to the tanks.

Before the installing of the reservoir it was a common occurrence for the mine mechanic to be informed, with the aid of the whistles of seven locomotives and three shovels, that the water supply was falling short of immediate requirements.

Lighting was both primitive and expensive, and did much to demonstrate the suitability of steam turbo-generators, mounted on and run from the locomotives and steam shovels, for this type of work. A 440-volt alternating-current generator driven by a Mogul engine produced the current, the pressure of which was reduced to 100 volts for lighting. Overhead cables were carried on poles from the power-house to the shovel cut, where there were fitted plug boxes at the foot of the poles. A cheap but portable standard was made from piping, and armoured flexible connections were fitted between these standards and the plug boxes. Two standards were placed on the top of the bank of the ore cut—one on each side in line with the cab so that the pit and cars were fully illuminated for every position of the dipper. The stripping shovel had a standard on the bank and another on the outside of the track. Each shovel had a connection to it from the nearest plug box, and carried one 60-watt gas-filled lamp above the levers and also an inspection lamp for the fireman.

The sidings where the cars were marshalled were illuminated by street-lamp type reflectors mounted on poles, and all switches and points were lit up wherever it was practical. The switch stands were all fitted with the R.R. type of oil-burning swivel lamps showing red and green to the drivers.

The series of views on page 595 give a good idea of the work described in the foregoing.

South Australian Water Supplies.

THE State of South Australia is situated between 26 deg. and 37 deg. south latitude, and 129 deg. and 141 deg. east longitude, the total area being 380,070 square miles. Rainfall varies from south-east to north-west, only some 63,000 square miles of coastal area receiving over 10in. per annum, the remaining 317,000 falling below that figure. Except for the river Murray, which flows for some 250 miles through the south-eastern corner into the Southern Ocean, there are no rivers of importance in the State. Such streams as exist are usually dry in summer and torrents in winter. One of the most notable features of South Australia is the widespread distribution of saline ground water, and the area in which potable well water—say, under ½ oz. of salts to the gallon—can be found without risk of failure is very limited. It is also noteworthy that most waters of the few streams are fresh at their heads, but become more or less saline as the streams are followed down. The artesian basins within the State cover a combined area of some 164,000 square miles, and supplies from these sources, which have been largely made use of, have proved of inestimable value.

Impounding reservoirs have been constructed in many places, so as to take the maximum advantage of such streams as exist, and, consequently, very long lengths of reticulation mains are necessary to supply land holders and others. The total area now supplied with water for domestic and stock purposes exceeds 20,000 square miles.

There are twenty-four impounding reservoirs in the State, with a total storage capacity of 16,796,906,000 gallons; forty-six service reservoirs; seven pumping stations on the river Murray; one

at the Blue Lake, Mount Gambier; one at Tod River; and eight others in country districts.

The capital cost of waterworks to date exceeds £11,000,000.

Adelaide Water Supply.

Adelaide, the capital of South Australia, is situated about 4 miles west of the Mount Lofty Ranges and about 6 miles east of the sea. The ground level at the General Post Office—which is about the centre of the city—is 154ft. above sea level. The water supply for the city and suburbs is obtained from the rain that falls on the watersheds of the Torrens and Onkaparinga rivers, the catchment areas of which comprise about 305 square miles. The average annual fall for the past twenty-five years on the Torrens catchment has been 30in. and on the Onkaparinga 34in.

Selected water only is taken from the catchment areas and stored in the four reservoirs that supply the metropolitan area. Two of the reservoirs, Thorndon Park and Hope Valley, are situated about 7 miles north-east of the city; another, Happy Valley, about 12 miles to the south; and the fourth, Millbrook, completed in 1918, about 17 miles to the north-east in the hills overlooking the Adelaide Plains. Thorndon Park was the first reservoir from which the city was supplied. It was constructed in the year 1857, has a holding capacity of 142 million gallons, and the water is obtained from the Torrens River. In the year 1872 Hope Valley reservoir was constructed to hold 765 million gallons. This reservoir is situated about a mile from that at Thorndon Park, and is filled from the same catchment. From these two reservoirs Adelaide and its suburbs obtained a supply until the year 1896, when, owing to the rapid increase in the population and to the extension of the water-carriage system of drainage, a further supply became essential. After various schemes had been considered, it was decided to obtain the additional supply from another watershed. The construction of the Happy Valley reservoir was commenced in 1891, and the new supply brought into operation in October of the year 1896. This reservoir has a holding capacity of 3194 million gallons. It is filled with water from the Onkaparinga River, which is conveyed through a tunnel 3½ miles in length into the reservoir. An embankment, ¼ mile in length, was constructed across the valley. Two masonry towers have been built. One of them controls the supply to the city, which is conveyed through an outlet tunnel 1¼ miles in length, and thence by a 3ft. steel main that supplies three smaller mains leading to the city and Port Adelaide. Three 18in. cast iron mains are laid from the old reservoirs for the supply of the city and suburbs, and a large new main has been laid from Hope Valley to increase the supply for Port Adelaide.

Owing to the largely increased demand for water for the city and rapidly extending suburbs, the Millbrook reservoir was started in 1913. It is the largest of the reservoirs in the State, and is supplied from the river Torrens by means of a concrete weir, 35ft. above the bed of the river, and a concrete conduit leading into an inlet tunnel, 1 mile long, thence by a short open channel into the reservoir, which, when full, contains an area of 440 acres, has a capacity of 3647 million gallons, and is 93ft. at its greatest depth and 85ft. 3in. above the bottom outlet. The inlet tunnel in connection with these works was started in October, 1913, and the construction of the embankment in February, 1914, the whole of the headworks being completed by December, 1919. The earthen embankment is 106ft. above the stripped level of the bed of the Chain-of-Ponds Creek, 995ft. long, 540ft. wide at the base, and 20ft. on top. The top water level of the reservoir is 999ft. above low water Port Adelaide. A steel locking bar pipe, 30in. diameter, trunk main has been laid from the Millbrook reservoir to connect with the reticulation of the city and suburbs.

The consumption varies from 12 million gallons per day in the winter to over 20 million gallons in the summer. The water is of good quality and is delivered to the consumers under a working pressure of 40 lb. to 90 lb. to the square inch. All premises where the main is available are rated on the assessed annual value. For every 20d. paid in rates, 1000 gallons of rebate water is allowed, and for excess above the quantity allowed for rebate the price is 1s. per 1000. The population now supplied is about 300,000 persons. The total length of mains laid is about 1200 miles, and the area embraced in the metropolitan water districts is 175 square miles. Ample provision has been made throughout the systems for fire brigades easily to obtain a good supply.

The total cost of the work in Adelaide district to date amounts to £3,241,024, and the net revenue for the year ended June 30th, 1926, was 7·35 per cent. on the capital cost.

Country Water Districts.

The principal country water districts are the Beetaloo, Barossa, Warren, Bundaleer, Tod River, &c., in which eighty-two towns, as well as country lands are supplied. In these districts there are six large reservoirs, three of which—Barossa, Beetaloo, and Warren—are formed by concrete gravity dams, and the other three—Bundaleer, Baroota and Tod River—by means of earthen embankments. The holding capacities of these reservoirs are as follows:—

	Gallons.
Barossa	993,347,000
Beetaloo	775,127,000
Warren	1,401,375,000
Bundaleer	1,374,007,000
Baroota	1,371,400,000
Tod River	2,318,000,000

Many miles of concrete channels and tunnels convey the water to the storage reservoirs from their different

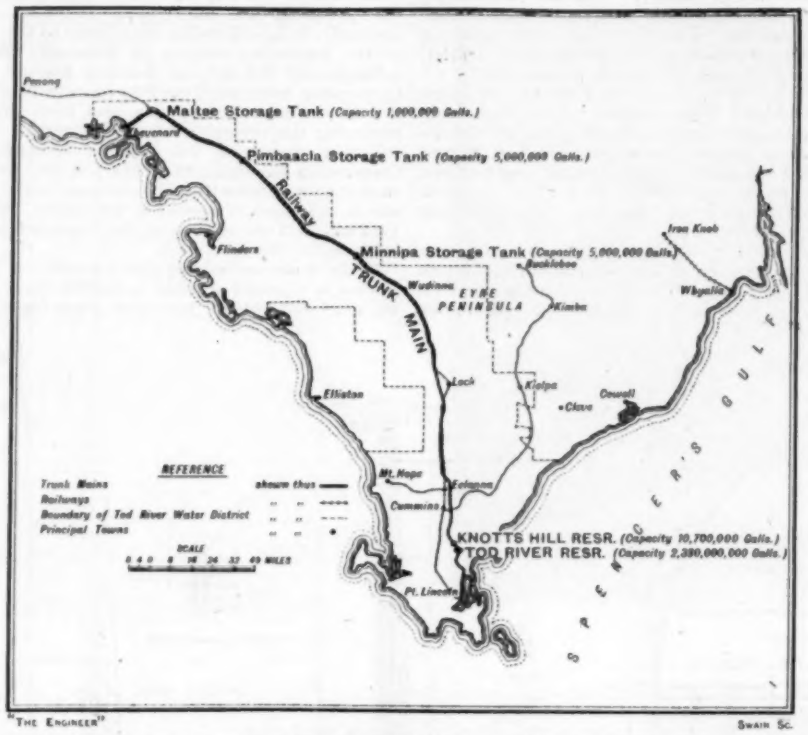


FIG. 1—AREA SUPPLIED UNDER THE TOD RIVER SCHEME

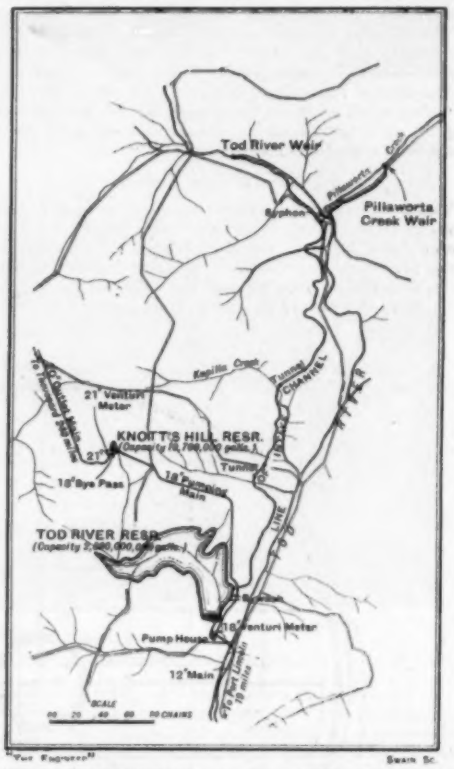


FIG. 3—NEIGHBOURHOOD OF TOD RIVER RESERVOIR

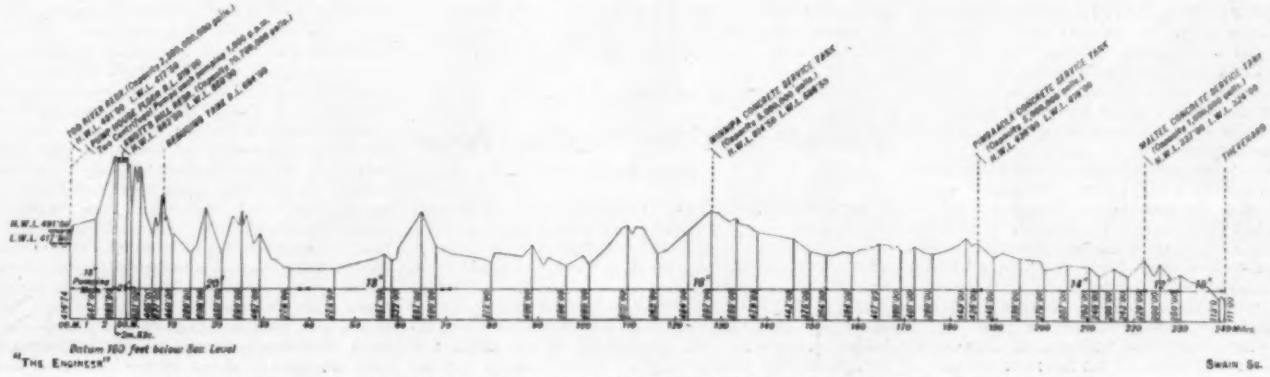


FIG. 2—LONGITUDINAL SECTION OF RISING MAIN FROM PUMP HOUSE TO KNOTTS HILL SERVICE RESERVOIR

5300 miles, the trunk mains in the larger districts being connected for the whole 300 miles. A good supply has been provided in each of the districts for all landholders, which is of immense value to the farmers as well as to the State. This comprehensive scheme of reticulation is unique in the history of waterworks, and there is probably no other part of the world where so large a district of agricultural land is supplied in so complete a manner for domestic stock and other farming purposes.

Several river Murray townships are supplied with water that is pumped from the river into elevated reservoirs or tanks. Mount Gambier, in the south-east, is supplied with excellent water pumped from the Blue Lake, which is the crater of an extinct volcano. The water is pumped from the lake into service reservoirs by a Robinson centrifugal pump, electrically driven. The area of the lake is about 170 acres, the average depth of water is from 250ft. to 280ft., and the height of the cliff about 250ft. above ordinary water level. The greatest variation in the level of the water recorded to date is about 14ft.

Other small schemes have been carried out for the supply of various country towns, and some of them have been leased to different trusts.

Tod River Water Scheme.

The most important scheme being carried out at the present time by the Hydraulic Engineer is the Tod River water supply. Briefly stated, the scheme provides for supplying water to an area of 9850 square miles situated on Eyre's Peninsula, as shown on Fig. 1. It is divided into (1) the high levels and (2) the low levels, the former possessing 9200 square miles and the latter 650 square miles. In order to supply water to the high levels, a pumping scheme was essential, and the length of the gravitation steel trunk main from Knotts Hill service reservoir to Cape Thevenard in connection therewith, is no less than 240 miles. The last 110 miles of trunk main are cement lined by the centrifugal process.

Fig. 2 is a longitudinal section of the rising main from pump house to a service reservoir situated on Knotts Hill, and the gravitation trunk main from Knotts Hill reservoir to Cape Thevenard. The latter work is rapidly nearing completion. About 500 miles of reticulation mains have been designed and over 100 miles of mains laid to date.

The total expenditure to date on this scheme is £1,714,720, and it is considered that the total cost of the scheme when completed will exceed £3,000,000. Except the river Tod there are no rivers or streams of note on the Eyre Peninsula, and the problem of a water supply was a matter of grave concern to the Government. The climatic conditions are favourable for wheat production, the rainfall varying from 10in. to 16in., so that considerable areas are under cultivation and development is proceeding vigorously. The catchment area is 68 square miles, and embraces Tod River, Pillaworta Creek and Toolillie Creek. A concrete diversion dwarf weir with regulator gates was built across the Tod River, and another with one regulator gate across Pillaworta Creek. The water from the latter is conveyed through a branch concrete-lined channel 4664ft. long, to make junction with the main channel leading from the weir across Tod River to the impounding reservoir, which has a storage capacity of 2400 million gallons—*vide* Fig. 3. The main channel is 5 miles 3939ft. in length. It is concrete lined, with a gradient of 1 in 1320, and it is capable of discharging 200 million gallons per diem.

The site of the impounding reservoir is on the Toolillie Creek in the south-west, and it is situated about 18 miles north of Port Lincoln. The earth embankment with puddle core has a height of 82ft. above the creek bed, 1153ft. long on top, 415ft. in width at the base, 20ft. on top, inner slope 3 to 1, outer slope 2 to 1, and is metalled with 8in. of stone on the inner and outer slopes. The area of water-spread is 335 acres. The usual valves are fixed. The outlet tunnel is of reinforced concrete and in it two 24in. diameter steel mains are laid. Water from the impounding reservoir gravitates to the pumps, and is forced through an 18in. diameter steel rising main 2 miles 52 chains long into the Knotts Hill service reservoir of 10 million gallons capacity. The pumping machinery is a producer gas plant, and multi-stage turbine pumps in duplicate. Each pump is capable of lifting 1000 gallons per minute against a total head of 515ft. when running at 1000 revolutions per minute.

From Figs. 1 and 2 it will be observed that three service tanks have been provided on the trunk main line; 5 million gallon tanks are under way at Minnipa and Pimbaacla, and a 1 million gallon tank at Maltee. The tank at Pimbaacla possesses several novel features, as will be noted upon reference to Fig. 4, which clearly shows the method of construction of the wall and floor.

In conclusion, it may be stated that the water supplies and sewerage schemes of the State of South Australia, together with the Revenue Department for same and the supervision of the Glanville Ironworks, are under the control of the Government Hydraulic Engineer, Mr. Herbert E. Bellamy, M. Inst. C.E., M.I. Mech. E., M. Am. Soc. C.E., M.I.E. Aus., &c.

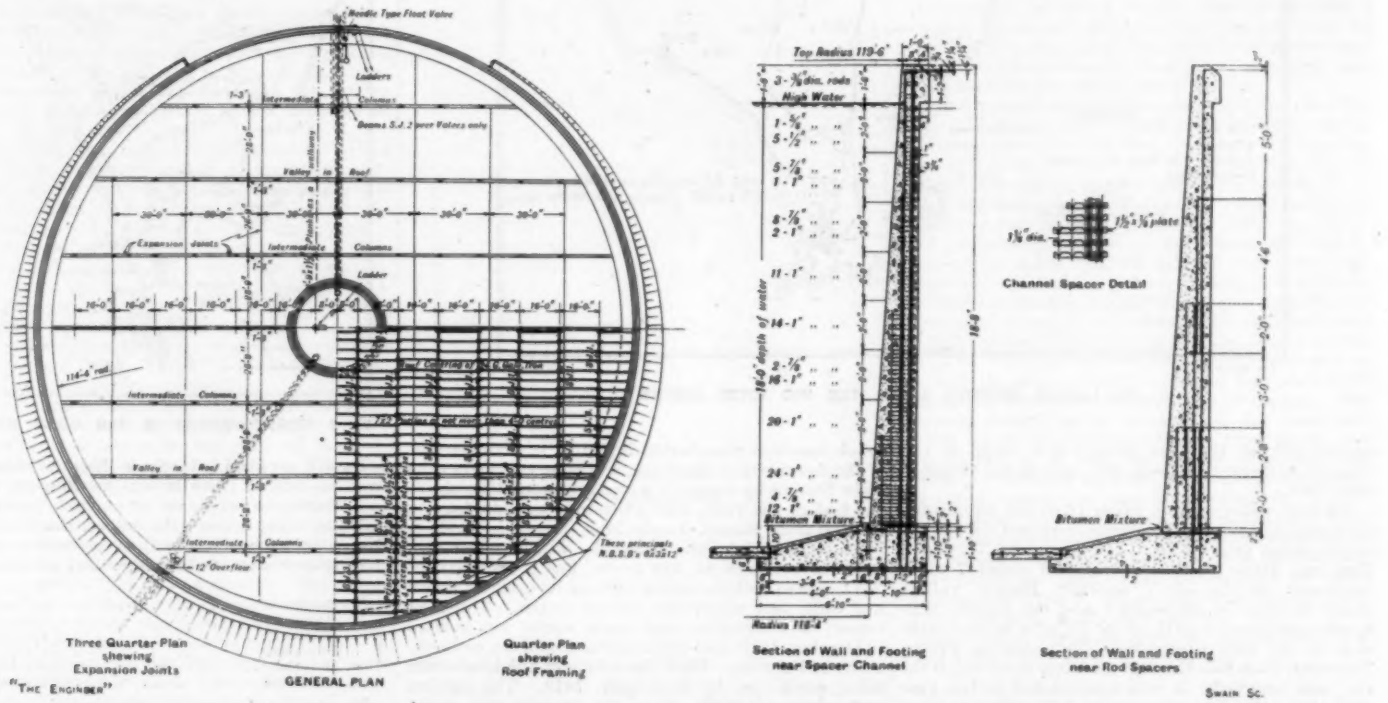

Three Quarter Plan shewing Expansion Joints
GENERAL PLAN
Quarter Plan shewing Roof Framing
"THE ENGINEER"
Section of Wall and Footing near Spacer Channel
Channel Spacer Detail
Section of Wall and Footing near Rod Spacers
SWAIN Sc.

FIG. 4—PLAN AND SECTIONS OF WALLS OF PIMBAACLA SERVICE TANK

Extensions at the Deptford Power Station.

As it stands to-day the Deptford electric generating station in which so much important pioneer work was undertaken, bears little resemblance to the station which Dr. Ferranti designed in 1887, for apart from two Ferranti sets that are now being dismantled to make room for turbo-generating plant of very much larger capacity and the original 10,000-volt switchboard, erected in 1892, practically all the plant is of comparatively recent origin. Soon, nothing beyond a few relics, preserved in the offices, such as samples of the original 10,000-volt cable and a drawing of the first Partridge oil switch, will be left to indicate that the station was at work in the early days of electrical engineering. The fact remains, however, that at Deptford the first attempt was made to generate 10,000-volt current, and that to a large extent modern developments in the electricity supply industry are based on Dr. Ferranti's ideas.

Like many other new schemes that have ultimately proved to be technically sound and desirable from a commercial point of view, the proposal to generate and transmit current at 10,000 volts was severely criticised when it was introduced, but in spite of all the opposition and innumerable difficulties that were met with, the high-pressure system was ultimately made a practical success. While transmission pressures considerably in excess of 10,000 volts are, of course, now in use, the pressure at which current is at present generated is very little higher than that originally adopted at Deptford. So much has been written on the history of this early station and on the many trials and troubles of the London Electric Supply Corporation that it is scarcely necessary to say anything more in that connection, beyond stating that during the war—to be precise, in the early hours of the morning of August 25th, 1916—a bomb was dropped on the station, with disastrous results. In addition to other damage, the entire traction and industrial switchboard was put out of action, but, notwithstanding that, within twenty-four hours the railway and power supplies were resumed, whilst the lighting supply was re-established within twelve minutes after the explosion, a fact that speaks well for the courage and ability of the Deptford engineering staff. It is well known that, prior to the erection of the generating station at Deptford, those who subsequently formed the London Electric Supply Corporation established the Grosvenor Gallery station, which was destroyed by fire, and from that small beginning the present extensive generating and distributing system of the London Electric Supply Corporation has emerged. How the load has grown since the year 1888 when the Grosvenor Gallery station was in operation is shown by the curves, Fig. 1, the 1912 and 1927 curves showing the combined maximum loads on the Deptford plant.

While it cannot be said that the existing Deptford station is a model of what a modern station should be, it is undoubtedly true that great ingenuity has been exercised in carrying out the work of reconstructing it, so as to make it conform with present-day requirements. Apart altogether from the fact that it is much more difficult to turn an old station into a new and modern station, and maintain the supply, than it is to design and construct an entirely new station, without having to consider how the plant can be got into existing buildings, the conditions of supply to be met at Deptford are somewhat exceptional. In addition to the local and London 83-cycle, single-phase load, the station also supplies 25 cycle, single-phase and three-phase current to the Southern Railway at pressures of 6600 and 11,000 volts respectively, and a certain amount of direct current to consumers in the locality. This direct current is obtained from a sub-station on the generating station site, which also contains single-phase transformers for the local alternating-current supply. The total traction load amounts to about 40,000 kilowatts, and in order to secure economical working of the 6600 and 11,000-volt, 25-cycle sets, which are both wound to generate three-phase current, they are tied together with transformers, and reactances are employed to limit short-circuit currents. When working on the Southern Railway Company's single-phase system, the machines are, of course, used as single-phase generators. Incidentally, it may be mentioned that in the past, the practice of connecting the single-phase lines of the Southern Railway directly to the station single-phase traction bus-bars gave rise to a great deal of trouble, owing to the frequent short circuits on the single-phase overhead wires, but, largely on account of the introduction of reactances on the railway system, this trouble has been practically overcome.

In our issue of August 9th, 1912, we described the

Deptford station as it stood at that date, but since then various additions have been made. The capacity of the plant at present installed in the station is over 100,000 kilowatts, and to accommodate this plant the original building has been considerably extended, and is still being extended for the accommodation of additional boilers. An entirely new 50-cycle station is also to be erected, and, we understand, that the new plant will be connected with that in the old station through a 25,000-kilowatt frequency changer. Coal is delivered to the station by means of two grab cranes of the horizontal luffing type, which grab the coal

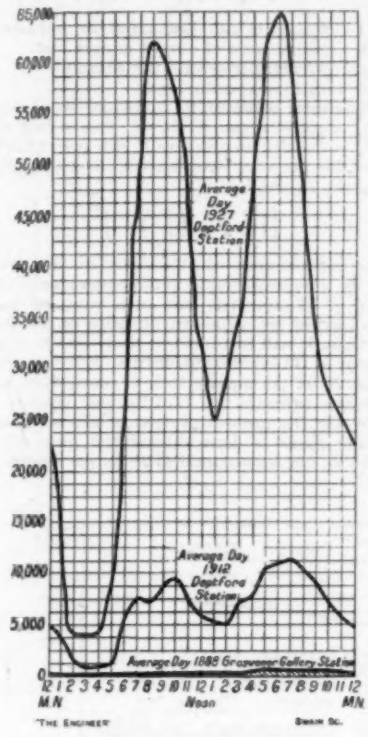


FIG. 1—LOAD CURVES

from barges and deliver it into a hopper from which it is raised by means of a telpher to a height of 90 ft., and delivered either to the bunkers or the coal storage pile, as required, weighing being carried out by means of a track weigher. The rate of unloading is 150 tons per hour. In the new boiler-house—shown in Fig. 2—there are fourteen boilers, each having a capacity of 50,000 lb. of water per hour, and an overload capacity of 65,000 lb. per hour. The steam pressure is 325 lb. per square inch, and the total temperature of the steam 725 deg. Fah. In the boiler-house extension now in the course of construction, six additional boilers are to be installed, each having a normal capacity of 64,000 lb., and an overload capacity of 80,000 lb. per hour. Each of the existing boilers has a steel tube economiser and air heater, designed so that the temperature of the gases discharged from the stack does not exceed 230 deg. Fah. The boilers have two travelling grates, 8ft. 6in. wide, and, as shown in the illustration, Fig. 2, two coal shoots are provided for each unit to enable two different kinds of coal to be burnt on the so-called sandwich system. Induced and forced draught fans for the balanced draught system are provided for each unit, and they are directly coupled to direct-current variable-speed motors. Measuring instruments are also fitted to each boiler. The older generating plant is worked at a pressure of 200 lb. per square inch, and the steam-raising units in the old boiler-house, which contains thirty boilers, are connected with those in the new boiler-house through reducing valves.

Seven pumps, all driven by steam turbines and with capacities ranging from 11,000 to 35,000 gallons per hour, supply the feed water to the new boilers, and the exhaust steam from the turbines is discharged into the high-pressure feed heaters, where it imparts the final temperature to the water before it enters the economisers, and as each boiler is fitted with regulators the whole action is automatic. From the hoppers beneath the boilers the ashes are discharged into a concrete trough in the basement—see Fig. 3—where they are transported in the well-known manner by a water sluice over a distance of 350ft. to a sump at the front of the wharf, where they are handled by a grab crane and loaded into a barge or wagon. The water in the trough is circulated by means of motor-driven centrifugal pumps in the pump house adjacent to the sump. It is drawn from the ash sump through a metal screen and is discharged into the far end of the trough. From the riddlings hoppers under the grates the riddlings are discharged into a system of ducts in the basement and are blown by air to the top of the bunkers at a height of 100ft., where they mix with the fresh coal.

The increased demand on the single-phase lighting system has been met by the installation of three 4000 kilovolt-ampère turbo-generator sets and a 7500 kilovolt-ampère set all generating at 2500 volts, the pressure being increased to 10,000 volts by means of step-up transformers, whilst for meeting the increased single-phase railway load and the growth of the industrial load an 8750-kilowatt and a 15,000-kilowatt three-phase turbo-alternator set generating at 6600 volts have been installed. Three 20,000-kilowatt turbo-alternators generating at a pressure of 11,000 volts have also been put down to give a supply to the South-Eastern section of the Southern Railway, and in order to meet the demands of this section of the railway another set of 25,000 kilowatts capacity will shortly be put into operation. With the exception of the generators that deal with the 85-cycle single-phase load, all the machines are wound for three-phase operation; but, as already indicated, they are arranged so that they can give a single-phase supply to the single-phase section of the Southern Railway. A view of one of the turbine room bays is given in Fig. 5 on page 604, in which there are eight turbines, the other bays being similar. All the new turbines are supplied with steam at a pressure of 300 lb. per square inch and at a temperature of 700 deg. Fah., and the turbines are bled at the high and low-pressure stages, the steam from the former being used for the evaporators, whilst that from the latter is used for the de-aerator connected with each main unit, which also has its own evaporator.

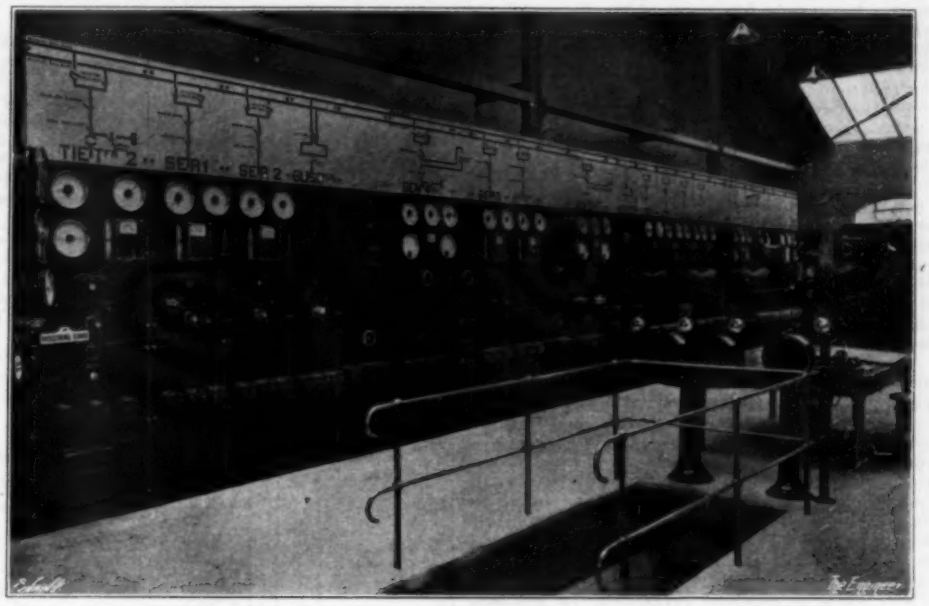


FIG. 4—SWITCH CONTROL ROOM

FIG. 2—INTERIOR OF NEW BOILER HOUSE

FIG. 3—ASH HANDLING PLANT

At the present time the closed feed system employed in connection with boilers having steel economisers, for the purpose of preventing air getting into the feed water, is well known to central station engineers, but at the time when the plans for these extensions were being prepared no completely closed feed system was at work. Many schemes were, however, examined, but none of them were considered suitable, and the engineers at Deptford finally devised a system themselves. After its removal from the condenser by the extraction pumps the condensate is pumped through a de-aerator heater of the surface flash type, from which all air is removed by a connection to the main condenser, whilst at the same time the temperature is raised by means of the steam bled from the low-pressure stage of the turbine. The action is practically automatic, a constant temperature being maintained at all loads and the vacuum in the water space of the deaerator corresponds to the temperature. The flow of water passing to the de-aerator is controlled by a float valve in the lower part of the vessel. A booster pump extracts the condensate from the de-aerator and delivers it to the suction of the feed pump and it is fed to the boilers through high-pressure feed heaters, which raise the temperature to 220 deg. Fah. Between the main condenser extraction pump and the de-aerator booster pump an open

surge tank is connected for the reception of any surplus condensate discharged by the condenser extraction pump during such times as the boiler pumps do not require it. In the event of the demand of the feed pumps being greater than that which can be satisfied by the main plant, the falling pressure on the discharge side of the extraction pumps allows the water stored in the surge tank to discharge into the de-aerator, where it is completely de-aerated before it is fed into the boilers. A noteworthy feature of the scheme is that there is a connection between the surge tank and the suction of the feed pump, called the pressure head line, with a non-return valve in the circuit. As long as the booster pump is working this non-return valve is kept closed by the discharge pressure of the booster pump, thus preventing this pump discharging into the surge tank, but if the booster pump fails, by reason of the pressure being removed from the bottom of the non-return valve, the pressure head line immediately comes into action, thus allowing the surge tank to discharge direct to the feed pump, the tank being placed at a height above the feed pump to ensure sufficient head on the suction. Each of the main turbines is provided with duplicate extraction pumps, one driven by steam and the other by an electric motor.

Make-up water for the boilers is obtained from the town mains and is either treated in a lime-soda plant or is passed through an evaporator. The water which is chemically softened passes through an independent de-aerator before it enters the boilers, whilst that from the evaporators is either discharged to the surge tank or otherwise mixed with the main condensate and is de-aerated with it as already described.

To meet the demand for circulating water for the surface condensers, an entirely new pump house—see Fig. 6 on page 604—was constructed and equipped with five motor-driven centrifugal pumps, each having a normal capacity of 1¼ million gallons of water per hour. The water is drawn from the Thames through a tunnel 10ft. in diameter, which is divided on the horizontal centre line, the bottom part forming the suction and the top part the return. On the station side the bottom or suction part of this tunnel ends in an open shaft, 20ft. in diameter, which acts as a sump for the reception of the larger and heavier *débris*, which is removed periodically by grabbing. From the shaft a tunnel, 10ft. in diameter, passes under the floor of the pump house, and to this tunnel the suction of the pumps are connected. Removable screens in the land shaft prevent timber or other floating material which may be drawn into the sump passing through into the pumps, whilst for removing the leaves and similar material, each pump is provided on the discharge side with a "Deptford" rotary strainer. After passing through these strainers the water is discharged into two 48in. cast iron pipes, which carry it to the turbine room, and after passing through the condensers it returns through two similar pipes, which are joined together a little beyond the land shaft, and pass into the top part of the tunnel, thus conveying the water back to the River. As the ends of the suction and discharge pipes are always sealed, the system works on the syphonic principle, with the result that the pumps only have to overcome the friction of the pipes and condensers. As far as possible, all valves on the pumps and condensers are electrically operated, and a safety device is provided to prevent overrunning. In order to obviate any suction lift and to ensure that the pumps are adequately supplied with water under all conditions of the tide, the pumps are sunk as low as possible in the pump house, and the tunnel from which they draw the water is at all times fed by gravity.

For accommodating the switchgear for the machines associated with the recent extensions, a switch house in the form of a brick building, 104ft. long by 52ft. wide, has been erected adjacent to the main turbine room. The new gear consists of twenty-seven oil switches arranged on the top floor, and behind a brick wall on the same floor is the control room—shown in Fig. 4—which has windows overlooking the turbine room, whilst, on the floor below, the duplicate bus-bars are placed directly under the oil switches. The switchgear is of the cellular type, and each switch has a rupturing capacity of 750,000 kilovolt-ampères. To enable the 6600-volt and 11,000-volt generating three-phase system to be connected together, to suit the running conditions, two 7500-kilovolt-ampère banks of forced oil-cooled transformers, with tertiary windings, are provided and connected in star. Means have also been provided for enabling the transformers to be switched on to the single-phase railway bus-bars, so that a 6600-volt supply can be given from the 11,000-volt generators, when, of course, only two of the three-phase windings are used. Incidentally, it should be mentioned that the three-phase railway load, which is dealt with from the control board to be seen in Fig. 4, has a power factor of practically unity, whilst that of the single-phase traction load is appreciably less than unity.

The method of mounting the current transformers which operate the relays is similar to that which was first employed at the Deptford power station, for they are slipped over the lead covering of the cable and are mounted as far away from the high-tension gear as possible, so that any fault on the bus-bars, &c., will not affect the apparatus upon which the clearing of the fault depends. For the same reason the control cables are kept quite distinct from the main cables, and where they pass into the bus-bar cell structure they are buried in the stone or otherwise arranged so that it is impossible for an arc to reach them. In addition to the reactors that are brought into service when the 6600 and 11,000-volt generating systems are tied together, reactors are also used on several of the feeders which serve the adjacent sub-station, in order to reduce the shock on the system in the event of a fault occurring.

The Proportioning of Nozzles for Explosion Turbines.

By E. C. WADLOW Ph.D., B.Sc.

IN spite of the inability of the internal combustion turbine to pass beyond the early experimental stage, there is evidence that the possibilities of this prime mover still possess some degree of attraction. During the last few years numerous papers[1] have appeared dealing with the general aspects of the problem, and the possible cycles of operation are well known. With regard to experimental work, the greater progress has been made, especially in Germany, with turbines working upon the constant volume or "explosion" cycle, and machines of considerable output have been constructed by Hans Holzwarth.

Among the many interesting problems found in turbines working on an "explosion" cycle is that of expanding the gas in the most efficient manner. The difficulty is due to the fact that the pressure in the combustion chamber, at the inlet to the nozzle, falls as the expansion proceeds, resulting in a constantly decreasing ratio of inlet pressure to exhaust pressure. Consequently, the exit velocity of the working fluid falls from a high initial value to zero during each cycle. In order to convey some idea of the magnitude of the changes involved, it may be observed that the exit velocity at the commencement of expansion may be in the neighbourhood of 4000ft. per second; 0·15 second later, it may have fallen to zero. The changes take place, therefore, with a rapidity so great as to render experimental investigation of the process of expansion in the nozzle out of the question at the present time.

It is clear also that it is impossible to design a nozzle which will provide the correct expansion ratio at every instant during the expansion period, and it becomes necessary to adopt a compromise. The nature of this compromise is a subject of considerable controversy, and it is the object of this article to collect the views of several authorities in order to obtain some idea of the position up to date, and of what further work may be necessary before the most satisfactory compromise is found.

By making certain assumptions, it is possible to calculate the theoretical throat area of a nozzle to satisfy the necessary conditions. The main condition is that the weight of working fluid contained in the combustion chamber after the explosion shall be discharged in a given time. The charge weight per explosion is readily calculated approximately from the known desired power of the turbine, the calorific value of the fuel, and the number of explosions per unit of time. It is assumed also that the time during which the working fluid expands has been fixed. When these particulars are settled, the theoretical pressure-time diagram for the turbine, and also the required nozzle throat area, may be obtained as follows:—

It is assumed, for simplicity of treatment, that the relationship between pressure and volume during adiabatic expansion is given sufficiently closely for this purpose by the usual equation—

$$P v^{\gamma} = K \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The weight of gas discharged through a nozzle, under a constant initial pressure P_1, is then given by

$$Q = A\left[2g\frac{\gamma}{\gamma-1}P_1 W_1\left\{\left(\frac{P_\circ}{P_1}\right)^{\frac{2}{\gamma}} - \left(\frac{P_\circ}{P_1}\right)^{\frac{\gamma+1}{\gamma}}\right\}\right]^{\frac{1}{2}} \quad (2)$$

where Q = weight of gas discharged, lb. per second.
A = throat area of nozzle, square feet.
g = 32·2ft. per second per second.
γ = ratio of specific heats.
P_1 = inlet pressure, lb. per square foot abs.
$P_\circ$ = outlet pressure, lb. per square foot abs.
W_1 = density at pressure P_1, lb. per cubic foot.

When the pressure drop exceeds the critical, the value of the expression—

$$\left\{\left(\frac{P_\circ}{P_1}\right)^{\frac{2}{\gamma}} - \left(\frac{P_\circ}{P_1}\right)^{\frac{\gamma+1}{\gamma}}\right\}$$

becomes independent of the value of the pressure drop; its numerical value is dependent only on the value of γ. Taking the case of a constant volume turbine having an explosion pressure of 250 lb. per square inch, it will be observed that the value of the last factor in (2) is constant until an inlet pressure P_1 of about 28 lb. per square inch is reached, assuming an exhaust pressure of 14·7 lb. per square inch. Since by far the greater portion of the work of the expanding gases is done during the pressure drop from 250 lb. per square inch to 28 lb. per square inch, the super-critical range is much the more important.

Putting—

$$W_1 = W_\circ \frac{P_1 T_\circ}{P_\circ T_1}$$

in (2), we have—

$$Q = A\left[2g P_1 W_\circ \frac{P_1}{P_\circ}\frac{T_\circ}{T_1}\frac{\gamma}{\gamma-1}\left\{\left(\frac{P_\circ}{P_1}\right)^{\frac{2}{\gamma}} - \left(\frac{P_\circ}{P_1}\right)^{\frac{\gamma+1}{\gamma}}\right\}\right]^{\frac{1}{2}} \quad (3)$$

where $W_\circ$ = density of gas at outlet to nozzle, lb. per cubic foot.
T_1 = temperature at inlet to nozzle, deg. Cent. abs.
$T_\circ$ = temperature at outlet to nozzle, deg. Cent. abs.

If $W_\circ$, $T_\circ$ and $P_\circ$ are fixed quantities, the equation (3), for inlet pressures above the critical, may be written—

$$Q = \alpha \frac{P_1}{\sqrt{T_1}} \quad . \quad . \quad . \quad . \quad (4)$$

where α is a constant.

The relationship between T_1, $T_\circ$, P_1 and $P_\circ$ is given by—

$$T_1 = T_\circ \left(\frac{P_1}{P_\circ}\right)^{\frac{\gamma-1}{\gamma}} \quad . \quad . \quad . \quad . \quad (5)$$

Suppose now that the nozzle is connected to an enclosed chamber which contains $M_\circ$ lb. of gas at pressure P_1, and temperature T_1. If the nozzle valve is opened instantaneously, the gas will be discharged at a rate—

$$Q_1 = \alpha \frac{P_1}{\sqrt{T_1}}$$

and at any subsequent instant, when the pressure has fallen to P and the temperature to T by—

$$Q = \alpha \frac{P}{\sqrt{T}}$$

If V_1 is the initial specific volume of the gas in the

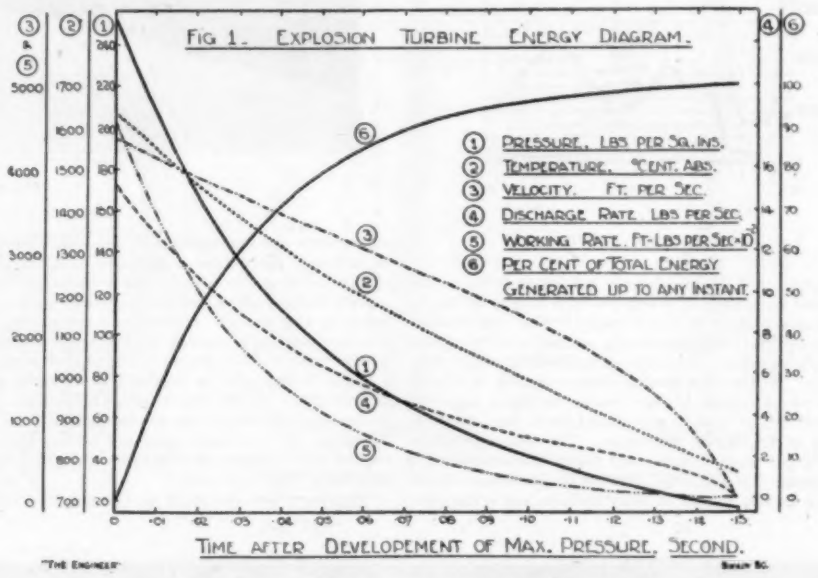


FIG 1. EXPLOSION TURBINE ENERGY DIAGRAM.
① PRESSURE, LBS PER SQ. INS.
② TEMPERATURE, °CENT. ABS.
③ VELOCITY, FT. PER SEC.
④ DISCHARGE RATE, LBS PER SEC.
⑤ WORKING RATE, FT-LBS PER SEC-0
⑥ PER CENT OF TOTAL ENERGY GENERATED UP TO ANY INSTANT.
TIME AFTER DEVELOPEMENT OF MAX. PRESSURE, SECOND.
"THE ENGINEER"

[1] Among others, see "The Gas Turbine in Theory and Practice," THE ENGINEER, Vol. CXXXV., No. 3514; "The Internal Combustion Turbine," W. J. Stern, Aeronautical Research Committee, Engine Sub-committee Report, No. 54; "The Gas Turbine," M. Konig, paper before North-East Coast Shipbuilders' Association, April, 1925; "The Internal Combustion Turbine," W. J. Goudie, Inst. Eng. and Shipbuilders of Scotland, paper read January 16th, 1925.

chamber, and at any subsequent instant it is V, the weight of gas left in the chamber at this latter instant is given by—

$$M = M_o \frac{V_1}{V} = M_o \left(\frac{P}{P_1}\right)^{\frac{1}{\gamma}} \quad . \quad . \quad . \quad (6)$$

The weight of gas which has passed out through the nozzle is consequently given by—

$$M^1 = M_o \left[1 - \left(\frac{P}{P_1}\right)^{\frac{1}{\gamma}}\right] \quad . \quad . \quad . \quad . \quad (7)$$

Now—

$$\frac{d\,M^1}{d\,t} = Q.$$

Therefore—

$$d\,M^1 = \alpha \frac{P}{\sqrt{T}}\,d\,t \quad . \quad . \quad . \quad . \quad (8)$$

Differentiating (7) with respect to P—

$$\frac{d\,M^1}{d\,P} = -\frac{M_o}{\gamma} \cdot \frac{1}{(P_1)^{\frac{1}{\gamma}}} P^{\frac{1-\gamma}{\gamma}} \quad . \quad . \quad (9)$$

Substituting in (8)—

$$-\frac{M_o}{\gamma} \cdot \frac{1}{(P_1)^{\frac{1}{\gamma}}} P^{\frac{1-\gamma}{\gamma}}\,d\,P = \alpha \frac{P}{\sqrt{T}}\,d\,t \quad . \quad (10)$$

or—

$$-\frac{M_o}{\gamma} \cdot \frac{1}{(P_1)^{\frac{1}{\gamma}}} P^{\frac{1-\gamma}{\gamma}}\,d\,P = \alpha \frac{P\,d\,t}{\sqrt{T_o}\left(\frac{P}{P_o}\right)^{\frac{\gamma-1}{2\gamma}}} \quad . \quad (11)$$

or—

$$K_1\,P^{\frac{1-3\gamma}{2\gamma}}\,d\,P = d\,t \quad . \quad . \quad . \quad . \quad (12)$$

where K_1 is a constant.

Integrating—

$$K_1 \int_{P_o}^{P_1} P^{\frac{1-3\gamma}{2\gamma}}\,d\,P = \int_{t_o}^{o} d\,t \quad . \quad . \quad (13)$$

or—

$$\frac{2\gamma}{1-\gamma} K_1 \left[P_1^{\frac{1-\gamma}{2\gamma}} - P_o^{\frac{1-\gamma}{2\gamma}}\right] = -t_o \quad . \quad (14)$$

Putting—

$$K_2 = \frac{2\gamma}{1-\gamma} K_1$$

we have—

$$K_2 \left[\frac{1}{P_1^{\frac{\gamma-1}{2\gamma}}} - \frac{1}{P_o^{\frac{\gamma-1}{2\gamma}}}\right] = -t_o \quad . \quad . \quad (15)$$

If the initial and final pressures and the time of expansion are known, the value of K_2 may be calculated. By using this, and substituting for P_1, an equation is obtained from which the pressure in the chamber at any desired instant may be calculated. The value of K_2 may also be obtained from the equation—

$$K_2 = \frac{2\,M_o\,P_o^{\frac{1}{2\gamma}}}{A\,(P_1)^{\frac{1}{\gamma}} \sqrt{2g\gamma(\gamma-1)W_o \left\{\left(\frac{P_o}{P_1}\right)^{\frac{2}{\gamma}} - \left(\frac{P_o}{P_1}\right)^{\frac{\gamma+1}{\gamma}}\right\}}} \quad (16)$$

If, however, K_2 has previously been obtained from (15), equation (16) serves to give the required value of A, since M_o, W_o, P_1 and P_o are known.

As an example of the use of these formulæ, a typical case has been worked out. It has been supposed that the combustion chamber contained 1 lb. of working fluid. The mixture is fired, and discharge commences immediately maximum pressure is reached. The explosion pressure is 250 lb. per square inch abs., the temperature after expansion 773 deg. Cent. abs., the outlet pressure 18 lb. per square inch abs., and the period of expansion 0·15 second. The equation giving the relationship between pressure and time is—

$$1{\cdot}472 \left[0{\cdot}2236 - \frac{1}{P^{\frac{\gamma-1}{2\gamma}}}\right] = -t.$$

The curve in Fig. 1 has been calculated from this equation. Since $K_2 = 1{\cdot}472$, A may be determined from (16) and is equal to 0·0429 square feet, or 6·18 square inches.

Assuming the properties of the gas to be those of air, the initial rate of discharge becomes approximately 15·07 lb. per second, and the weight of gas left in the chamber at the end of the expansion is approximately 0·153 lb. from (6). The rate of discharge for other inlet pressures is also shown in Fig. 1, and a planimetric measurement of the area contained by this curve and the axes gives the total weight discharged. The sum of the weights of fluid discharged and of fluid remaining in the combustion chamber will not, however, be exactly equal to the initial charge weight, for the equations, of course, are inaccurate when the pressure drops are less than the critical. As the energy generated during this range is small in comparison with that generated in the super-critical, the error is not of very great importance in a field where other difficulties can only be overcome by making general assumptions.

It is unfortunate also that most of the published diagrams taken from Holzwarth's turbines are very small, and that in most cases the scales of the ordinates are not clearly marked. This renders analysis difficult and uncertain. As far as the writer is aware, the best available are those given in the paper by König,[2] and two of these have been reproduced in Fig. 2, together with the ideal curves as calculated from equation (15). In order to effect a comparison with indicator diagrams, taken from a constant volume piston engine, Fig. 3 has been prepared. The original diagram was a typical one taken from a 20 B.H.P. Crossley gas engine running at 260 r.p.m. on Mond gas. The time taken for the pressure to fall from its maximum to its minimum value is therefore similar in both cases. The ideal curves, calculated from (15) appear to bear a similar relationship to the actual curves for both piston and turbine constant volume cycles, but this agreement is undoubtedly due to different causes. In the case of the turbine, the fact that the nozzle valve does not open instantaneously will tend to keep the actual pressure-time curve above the theoretical during the early portion of the cycle. If, for instance, the nozzle valve is not fully open until 0·02 second has elapsed, equation (16) does not apply until after this period, *i.e.*, until the value of A becomes constant. The agreement between actual and theoretical diagrams for the turbine is then much better.

The variable nozzle opening during the early expansion period also calls for a modification of the equation for calculating the throat area. Considering the lack of knowledge concerning nozzle coefficients and the interchange of heat between the gas and the

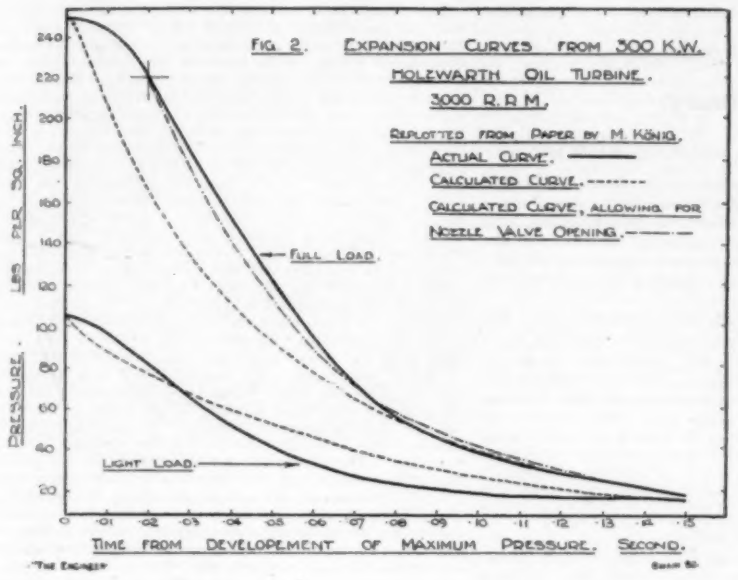


FIG. 2. EXPANSION CURVES FROM 300 K.W. HOLZWARTH OIL TURBINE. 3000 R.P.M.
REPLOTTED FROM PAPER BY M. KÖNIG.
ACTUAL CURVE.
CALCULATED CURVE.
CALCULATED CURVE, ALLOWING FOR NOZZLE VALVE OPENING.
FULL LOAD.
LIGHT LOAD.
PRESSURE. LBS PER SQ. INCH.
TIME FROM DEVELOPEMENT OF MAXIMUM PRESSURE. SECOND.
THE ENGINEER

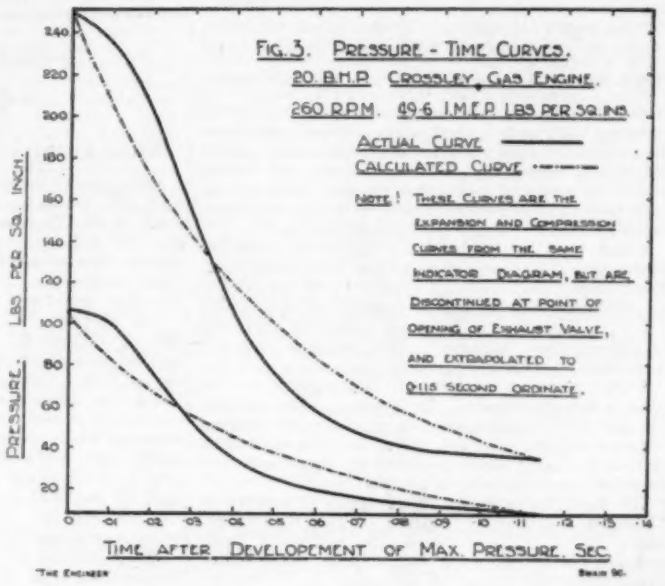
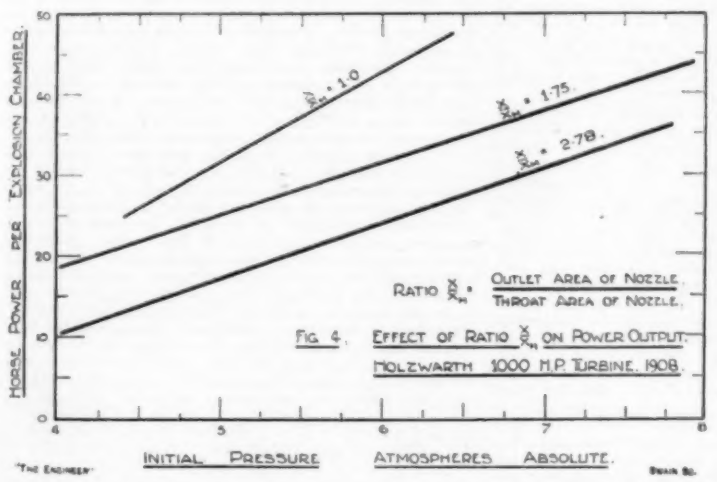


FIG. 3. PRESSURE - TIME CURVES.
20 B.H.P. CROSSLEY GAS ENGINE.
260 R.P.M. 49·6 I.M.E.P. LBS PER SQ. INS.
ACTUAL CURVE
CALCULATED CURVE
NOTE! THESE CURVES ARE THE EXPANSION AND COMPRESSION CURVES FROM THE SAME INDICATOR DIAGRAM, BUT ARE DISCONTINUED AT POINT OF OPENING OF EXHAUST VALVE, AND EXTRAPOLATED TO 0·115 SECOND ORDINATE.
PRESSURE. LBS PER SQ. INCH.
TIME AFTER DEVELOPEMENT OF MAX. PRESSURE. SEC.
THE ENGINEER


HORSE POWER PER EXPLOSION CHAMBER.
RATIO Outlet Area of Nozzle / Throat Area of Nozzle
FIG. 4. EFFECT OF RATIO ON POWER OUTPUT. HOLZWARTH 1000 H.P. TURBINE. 1908.
INITIAL PRESSURE ATMOSPHERES ABSOLUTE.
THE ENGINEER

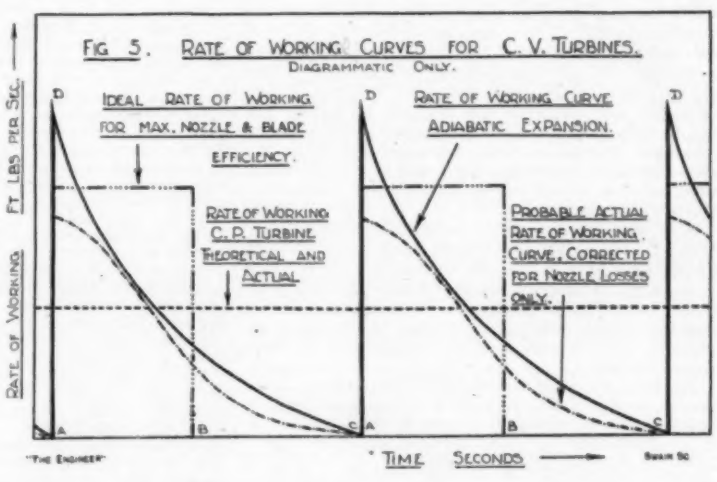


FIG. 5. RATE OF WORKING CURVES FOR C. V. TURBINES.
DIAGRAMMATIC ONLY.
IDEAL RATE OF WORKING FOR MAX. NOZZLE & BLADE EFFICIENCY.
RATE OF WORKING C. P. TURBINE. THEORETICAL AND ACTUAL
RATE OF WORKING CURVE ADIABATIC EXPANSION.
PROBABLE ACTUAL RATE OF WORKING CURVE, CORRECTED FOR NOZZLE LOSSES ONLY.
RATE OF WORKING. FT. LBS PER SEC.
TIME SECONDS
THE ENGINEER

[2] "The Gas Turbine," M. König, paper before North-East Coast Shipbuilders' Association, April, 1925.

nozzle walls under these conditions, however, the equations given are sufficiently accurate for the purposes of design.

The controversial question is, however, what ratio the nozzle outlet area should bear to that at the throat in order to secure the maximum energy output from the machine.

The view of Holzwarth, the pioneer in explosion turbine construction, is particularly interesting and important, and is briefly expressed in the following extract taken from the 1912 edition of his book[3] (English translation): "It may be mentioned that it is desirable for the total velocity to be developed in the nozzle itself. . . . It is therefore of importance, particularly during the first portion of the expansion, where there should be a large heat drop, that the maximum velocity should be reached in the nozzles."

Holzwarth's experiments on this point, however, seemed to show that the best results were obtained with a ratio $\frac{\text{exit}}{\text{throat}}$ area of unity. The full results, extracted from his book, are given in Fig. 4. As the variation with ratio is very marked indeed, and there is no indication that the most favourable blade angles and speeds were employed in the tests, the results cannot be accepted as conclusive, and the improvement is in the opposite direction to that which Holzwarth's statement would lead one to expect.

Morley,[4] as the result of a theoretical investigation, states: "It would seem that the direction in which improvement of this type is to be sought lies in increasing the available energy at the nozzle . . . rather than in adopting means to make the jet velocity more uniform." This, however, does not bear directly upon the problem.

Stern,[5] after an analysis of Holzwarth's results, gives a definite opinion. He states: "The nozzles, too, should be dimensioned to work for the smallest pressure difference in the cycle, *i.e.*, the expanding part of the Laval nozzle becomes less important, and the nozzle approximates to a plain tube."

The anonymous writer of the series of articles on "The Gas Turbine," published in THE ENGINEER,[6] states: ". . . and the nozzle, instead of being designed for the maximum single speed, is preferably arranged for the lowest of the range . . . though the exact proportioning for a given range may require some experiment."

Most of the remaining writers on the gas turbine make no definite statement on this exceedingly interesting point.

The same uncertainty is found in the field of practical achievement. The nozzles of Holzwarth's turbines are apparently convergent or of the convergent-parallel type. Barron, Dale and Packham, however, who employ the same cycle of operations, are stated by König[7] to be using nozzles of the convergent-divergent de Laval type, machined all over, with parallel exits.

Thus, there is no agreement in either theoretical or practical fields.

Referring to Fig. 1, on which has been plotted a curve showing the percentage of the kinetic energy which has been generated up to any instant after the commencement of the expansion, for the example previously considered, it will be observed that over 90 per cent. of the kinetic energy is generated during the first half of the expansion period, during which time the inlet pressure has fallen from 250 lb. per square inch to about 60 lb. per square inch. Clearly, therefore, the sub-critical expansion period is the least useful, and to design the nozzle so that its maximum efficiency occurs in that range seems unreasonable.

It is also interesting to consider the ideal rate-of-working – time diagrams for both constant volume and constant pressure cycles. In the latter cycle the rate of working is constant, as represented by the horizontal line in Fig. 5. In this case the nozzle and blades, working under steady conditions, have one most efficient form, which may be found after a little experimenting.

The rate-of-output diagram for an explosion turbine cannot extend indefinitely in a horizontal direction, owing to the intermittent nature of the cycle, but it may conceivably be made up of a series of evenly spaced rectangles along a time base, as in Fig. 5, which is diagrammatic only. The nozzle and blades are then working under steady, and therefore most favourable, conditions during the time interval A B. During the time interval B C no work is being done. Consequently, the only losses are windage losses. This would give the most efficient arrangement from the point of view of the nozzle and blades only.

In an actual turbine, however, the expansion is approximately adiabatic, the rate-of-working curve assumes a form similar to D C, and the working conditions for nozzle and blades immediately become unfavourable. It will be observed, however, that the losses in the blades may be minimised by selecting a nozzle the efficiency curve of which tends to make the adiabatic rate-of-working diagram approach the rectangular form. The form of diagram suggested is indicated in Fig. 5.

There are other details which cannot be dealt with fully here. It is clear that there is no definite agreement, either in theoretical fields of study or in turbines actually constructed, and a consideration of existing efficiency diagrams for various types of nozzle only serves to show the difficulty of predicting the actual overall efficiency of a combination of nozzle and blades operating under the "gust" system. The one conclusion which can be reached is that a satisfactory answer to the problem will only be obtained from full-scale experiments, upon nozzle and blade arrangements designed especially to investigate this point. Until these experiments have been carried out, considerable differences of opinion appear to be inevitable.

[3] "The Gas Turbine," Hans Holzwarth. Translated by A. P. Chalkeley (Griffin and Co.).

[4] THE ENGINEER, March 27th, 1914.

[5] "The Internal Combustion Turbine," W. J. Stern, Aeronautical Research Committee, Engine Sub-committee Reports. No. 54.

[6] THE ENGINEER, Vol. CXXXV., No. 3514.

[7] "The Gas Turbine," M. König, paper before North-East Coast Shipbuilders' Association, April, 1925.

Obituary.

THOMAS WILLIAM STAINER HUTCHINS.

WE regret to have to announce the death on Friday, 27th ult., at his home, Hartford Lodge, near Northwich, of Mr. Thomas William Stainer Hutchins, who was for some years the managing director of the Electro Bleach and By-products Company, at Middlewich, Cheshire, which was subsequently absorbed by Brunner, Mond and Co., Ltd.

Mr. Hutchins was formerly connected with the Mersey Engine Works and was the patentee of a suction gas plant which was afterwards taken up by the Power Gas Corporation, Ltd., of Stockton-on-Tees. Mr. Hutchins transferred his services to that company at the same time, and while he was so engaged was responsible for a scheme for recovering ammonium sulphate from outcrop coal in Natal. During the late war the works of the Electro Bleach and By-products Company were taken over by the Government for the manufacture of chlorine and other ingredients for gas warfare.

Mr. Hutchins was a man with considerable inventive ability and during recent years had devoted attention to the apparatus for the electrolytic deposition of metals and the distillation of shales for oil, for which a company called the Fusion Syndicate, Ltd., Middlewich, was formed.

Mr. Hutchins was elected an associate member of the Institution of Mechanical Engineers in 1911 and was transferred to full membership in 1925.

Timber Viaduct Over the Tunuyan River.*

By T. C. S. HASLAM, Assoc. M. Inst. C.E.

THE city of Mendoza is the western terminus of the Buenos Aires and Pacific Railway Company's transcontinental line from Buenos Aires. Here passengers for the neighbouring Republic of Chile tranship on to the Transandine Railway. Mendoza is situated at the foot of the Andes on the eastern side of that mountain chain, and is the centre of an important and rapidly growing irrigated zone, which is principally devoted to vine growing.

About 66 miles to the south of Mendoza lie the village and district of San Carlos, and a branch line to connect the two was commenced about sixteen years ago. Owing to various circumstances, however, only 48 miles were completed, leaving San Carlos still more or less isolated from railhead by the river Tunuyan, which, spanned by only one road bridge, and impossible to ford except during the winter months, formed a very serious obstacle. In 1922 it was decided to push the line through to its termination with all possible speed, and work was commenced in November of that year. As the instructions given to the engineers were to complete the line by the end of April, 1923, the greatest problem to be tackled was the bridging of the Tunuyan River, which from December to March is generally in flood.

The Tunuyan is chiefly fed by glaciers and the winter's fall of snow on the lower slopes of the mountains, thus, when the summer freshets occur, large quantities of detritus are carried down. The larger rocks and boulders are deposited soon after the river emerges from the mountains, these deposits gradually decreasing in size as the distance from the mouth of the gorge increases and the slope of the river bed becomes flatter.

The site selected for the railway bridge was approximately 6 miles from the point where the Tunuyan runs out of the mountain gorge, and at this spot the river bed consists entirely of gravel, the stones ranging from 1in. to 8in. in diameter, interspersed with a few boulders weighing several tons each.

At the time of year when it was expected that work would be commenced on the bridge the flow is 250 cubic metres per second, with a surface velocity of approximately 3 m. per second. In spite of the unsuitability of such a bed for pile-driving, a piled structure was the only feasible solution under the circumstances, any other form of foundation being far too slow and costly. It was therefore decided to build a timber piled viaduct 120 m. long and of a temporary nature.

Description of the Bridge.—The viaduct consists of thirty-one bents of four piles each, spaced 4 m. apart centre to centre. The 14in. by 14in. piles are of pitch pine treated with two coats of "carbolineum" preservative and shod with heavy cast iron shoes. A 14in. by 14in. transom was laid across the tops of the four piles, and the whole bent stiffened with 8in. by 3in. diagonal and horizontal bracing. The longitudinal girders carrying the track consist of beams made up with 100 lb. rails laid "heads and tails" six to each beam, a method which was both quick and economical, as the rails were held in stock by the railway company, but not actually required at the moment.

Construction.—It was impossible, owing to the state of the roads, to do any work on the bridge before railhead reached the river, so that a start was not made until February 15th, on which date the first attempt at pile-driving was made with a McKiernan-Terry 2-ton steam hammer. The result was very disappointing, as the pile only penetrated 2ft. 8in. below the bed of the river, and no amount of hammering made any further impression on it. A second pile was then tried with similar results. Finally a third pile was driven with a Sissons-White 1½-ton drop hammer, but without any improvement in the result.

The author then evolved the following scheme, which was very successful, and though the process may seem at first sight to be somewhat laborious, once the men got accustomed to the work progress was fairly rapid. A second pile-driver was ferried across to the far side of the river, so that work on the viaduct was carried on from both ends. First, two flat-bottomed 70 lb. rails, 10 m. long, were riveted together, flange to flange, and one end of the beam thus formed was roughly forged into a point. The large drill thus made was driven by the pile-driver 2ft. 6in. into the river bed. A 1in. diameter galvanised iron pipe was let down to the bed on the upstream side of the drill, the velocity of the water keeping it in place in one of the channels formed by the heads and flanges of the rails of which the drill was made. The upper end of the pipe was connected by a flexible hose to a Worthington steam pump, which pumped water through it at high pressure. The drill was then withdrawn and the pipe jet was slipped into the hole to clear out the sand, being worked down by hand to the same depth as that attained by the drill. The connection at the upper end was then unscrewed and two dynamite cartridges with waterproofed fuse attached were let down the pipe. When these reached the bottom the pipe was withdrawn to within a few inches of the river bed and the charges were exploded. It was found that if the pipe was withdrawn 2ft. it was not damaged by the explosion. The reason for not withdrawing it altogether was that, if it had been, the fuse would have been carried away by the water. As soon as the charge was exploded the drill was lowered again, driven another 3ft., and the operation just described was repeated. After drilling in this way to a depth of 10ft. approximately a final charge was exploded and the pile was driven. The average penetration of the wooden piles driven by this method was 13ft., which was sufficient to render the structure perfectly safe.

The method described was employed throughout the piling operations, and the viaduct was completed at the beginning of May, railhead reaching San Carlos by the middle of that month.

* Abstract of a paper communicated to the Institution of Civil Engineers.

SIXTY YEARS AGO.

IN the 'sixties of last century steam propulsion at sea was still regarded by many people with a certain amount of distrust. Breakdowns of machinery were not infrequent, and as a consequence it was a general practice to equip all vessels intended to remain long at sea with masts and spars capable of showing a good spread of canvas. Coasting and Channel steamers ran no great risk of failing to be rescued in the event of their machinery breaking down, and even Atlantic steamers were not thought to be in great danger from the same cause. These vessels were therefore provided with masts and sails, which would afford them some assistance in an emergency, but which were quite disproportionate to their size. Australian and Indian liners, however, were in a different category, and even in the finest screw ships steam power was subordinated to sail power. In the Navy the principle of combining steam and sail power in the one vessel had reached its fullest development. The screw, introduced as an auxiliary, had come to be regarded as the principal means of propulsion, but in spite of that fact the area of canvas provided had not been decreased, but in some cases had actually been made greater than that adopted in old wooden frigates and line-of-battle ships, which were dependent entirely on sail power for their propulsion. It was held to be necessary to make the warships of the period independent of their steam machinery, because of the long periods for which in wartime they might be required to keep the sea, because of the high cost of coal abroad, and because few or none of the ironclads could carry fuel for full power more than sufficient to last six or eight days at the utmost. The combination of steam and sail power in the one vessel gave rise to problems of design which were the subject of considerable controversy. The object to be achieved was to fit the propeller in such a way that when not in use it would leave the sailing powers of the vessel unaffected. Many authorities, including the Admiralty, favoured the use of a two-bladed screw, largely because when not required for propulsion it could be set in the body of dead water moving with the ship, in which position it offered very little resistance to forward progress. An official report from the Admiral commanding the Channel Squadron was quoted in our issue of May 31st, 1867, as providing evidence in favour of the four-bladed screw. The great advantage of that form of screw over the two-bladed design was the reduction of the vibration transmitted to the stern framing. As for the retardation which was held to be an objectionable feature of the four-bladed screw, experience, it seems, showed that the increased resistance caused by the two extra blades practically disappeared if the screw was uncoupled from the engine and allowed to rotate freely under the forward motion of the ship derived from her sails.

THE War Office has placed a contract for 56,000 dozens of hacksaw blades with the Sheffield and Hallamshire Hacksaw Company, Ltd., of Sheffield.

Railway Matters.

THE Belfast steamship service of the London, Midland and Scottish Company will be transferred from Fleetwood and centred wholly on Heysham on November 19th next.

THE line of the Southern Railway Company between Kent House and Beckenham Junction is to be widened from two to four lines of way. The work includes the reconstruction of the bridge over the Mid-Kent Railway and of that over Blakeney-road. The widening is to be put in hand at once, and it is hoped to complete it in twelve months. The cost will be about £100,000.

THE retirement is announced of Mr. H. P. Maynard, the maintenance engineer under the engineer-in-chief of the Great Western. For some years now it has been necessary for us to apply to Mr. Maynard for information for our annual article on railways, and we would endorse the following remarks in the May issue of the Great Western Railway *Magazine* : "On account of his helpful disposition, Mr. Maynard enjoyed an unusual popularity among the officers and staff of all departments, and his retirement is greatly regretted. The best wishes of all his friends accompany him in his retirement."

THE length of electrified railways in Italy at the end of 1926 was 1093 kiloms. That figure should be added to the Pistoia-Perretta line, recently completed, and 132 kiloms. from Bologna to Florence, to be opened this year. The geographical distribution of the electrified lines (in kilometres) is as follows:—Turin, 329; Genoa, 295; Milan, 272; Florence, 108; Venice, 75; and Naples, 14. Of the total length of electrified railways 1018 kiloms. belong to the State, while 75 kiloms. (Trento-Male, 60 kiloms., and Brunico-Campo Tures, 15 kiloms.) are the property of private parties but operated by the State Railways. Of the lines constructed 605 kiloms. are double track and 488 kiloms. single. The traction system is three-phase, 3700 volts with two aerial phases, except on the Milan-Varese-Porto Ceresio and the Naples-Pozzuoli lines, which are operated with continuous current at 650 volts. Included in the above total is a line of 11 kiloms. in French territory operated on account of the Paris-Lyons-Méditerranée company.

ATTENTION has twice been drawn to the Channel Tunnel in the last few weeks. First, by the death of Mr. W. T. Perkins, who was the secretary of the Channel Tunnel Parliamentary Committee; and, secondly, by a question addressed by a Labour Member to the Prime Minister. Mr. Baldwin, in reply to the latter, said that the scheme was definitely condemned by the Government of the hon. member's own party, and he was not prepared to reopen the question, having regard to the considerations upon which a decision had been taken. As a matter of fact, it was the Committee of Imperial Defence which condemned the scheme, and Mr. Ramsay MacDonald, in announcing, on July 7th, 1924, that Committee's decision, said that, with a view to remove the question from party politics, he had invited four former Prime Ministers—Lord Balfour, Mr. Asquith, Mr. Lloyd George, and Mr. Baldwin—to assist in its deliberations. A remark made by Mr. MacDonald must always be remembered in this relation. He said, "I think that most of those present, like myself, had approached the question with a certain predisposition in favour of the Channel Tunnel. When the evidence came to be discussed, however, it was found that everyone had been forced to an opposite conclusion."

THE collision at Gale-street halt, between Barking and Dagenham on the Tilbury section of the London, Midland and Scottish Railway, to which reference was made on page 637 of THE ENGINEER of December 10th last, was the subject of an inquiry by Lieut.-Colonel Hall, whose report thereon has recently been issued. The driver of the second passenger train passed a distant and a home signal which were against him. He said that, owing to a fog, he could not see them. The driver of the train into which his train ran did, however, see the signals, but, granted that they were obscured, the man failed to act in accordance with the rules governing signals which are not seen. The driver of the second train had found fogmen on duty at all the distants up to the one he missed, and he possibly assumed that because he exploded no detonator there the signal was in his favour, as when a signal is put to "clear" the detonator is withdrawn from the rail. On the other hand, all the evidence showed that whilst the fog was bad elsewhere, it was not so at Barking, at which station is the distant signal the driver said he missed. Colonel Hall points out that the collision is typical of the class of accident that automatic train control would prevent. A full stop at the home signal missed by the driver would have prevented the collision, and a check at the distant signal would probably have done so.

IN the record in our last issue of the events of "Sixty Years Ago," mention was made of a very interesting page in railway history, the conclusion of which may perhaps be stated. The Bill for the absorption of the Glasgow and South-Western Railway by the Midland, that was before Parliament sixty years ago, passed the House of Commons but was rejected by the House of Lords. No explanation was offered for that step, but it was generally assumed that the reason was that as the Settle and Carlisle line of the Midland Company had not been built, there would be eighty miles separating the two properties. As we remarked last week, the two companies had to wait until the Railways Act, 1921, for their amalgamation, but it may be noted that a large amount of Midland capital was indirectly vested in the Glasgow and South-Western, and for some years the two lines had the same chairman in Matthew William Thompson, of Bradford, who was also the chairman of the Forth Bridge Company, and was made a baronet when that great work was opened in 1891. Another interesting phase in the Midland Company's Scottish policy developed soon after the above-mentioned events in 1867. Its great rival, the London and North-Western, adopted a more conciliatory attitude towards the Midland's aspirations, and the result was a Bill in 1869 to abandon the Settle and Carlisle line. The Lancashire and Yorkshire, however, wanted another route to Scotland than by the North-Western, and the North British wished to be more independent of the North-Eastern, and so they opposed the abandonment, and the Bill was rejected.

Notes and Memoranda.

ACCORDING to Mr. J. F. Lincoln, of Cleveland, Ohio, machine parts, such as lathe beds, if made of steel sections welded together by means of the arc, would be cheaper and better than the usual cast iron beds.

ACCORDING to Dr. J. M. R. Fairbairn, Chief Engineer, Canadian Pacific Railway, 20 per cent. of the class of '23 in applied science at the University of Toronto found employment in the United States. Each graduate—taking the average man, rather than the leader—has a capitalisation value to the State of at least 90,000 dollars in earning power alone, and this without reference to the effect of his work on industry in general.

IN the course of a recent lecture to the British Commercial Gas Association, Dr. R. Veitch Clark, Medical Officer of Health for Manchester, said that each year the atmosphere deposited 20,000 tons of foreign matter on Manchester; 76,000 gallons of tar were thrown off in the raw consumption of coal; 210,000 gallons of concentrated sulphuric acid were deposited. The deposit in Manchester was more than six times that in Baguley, only 6 miles from the centre of the city. On the average, Manchester received, in 1926, only 55 per cent. of the light enjoyed at Timperley, a like distance away. With northerly winds, however, the light incidence in Manchester ranged from 85 to 130 per cent. of Timperley's, as the northern winds carried Manchester smoke southwards. During general fogs, Manchester's light fell to 5 per cent. of Timperley's, and even to zero.

IN a recent official report the Engineer Surveyor-in-Chief says:—"This report deals with the failure under ordinary working conditions of a very large cast iron steam pipe, in which, owing to movement of and damage to the core during casting, the thickness of metal varied from about ⅞in. to 1⅛in., the change of thickness in some parts being very abrupt. The metal at certain points was also spongy, and the pipe appears to have failed initially at one of these thin and spongy places, and then to have been shattered to pieces. The case illustrates very clearly the need for the most careful examination of new cast iron pipes that are to be subjected to high steam pressures and to the great variations of temperature and stress which such pipes have to sustain in service. No pipe in which a serious difference of thickness is found to exist should be used in a high-pressure steam pipe range."

FOR the past twenty years, states the *Electrical Review*, a power transmission line on the Thury high-voltage, direct-current, variable-voltage system has been in operation between Moutiers and Lyons, France, for the supply of power for the tramway system in the last-named city. The system has worked well, the only difficulty encountered having been that of the supervision of the line between Chambery and Novalaise, a distance of nearly 20 miles, where an altitude of 3290ft. is attained and the weather is very severe, especially in winter. To overcome this drawback the Société Générale de Force et Lumière recently decided to install a new underground cable on this section of the line, and has placed a contract with the Compagnie Générale des Cables, of Paris, for a direct-current cable capable of working at 150,000 volts and of attaining 300,000 volts between the positive and negative wires with the central point earthed.

THE temperatures at which coals begin to decompose are of considerable importance, both for technical purposes and as an aid to the study of the constitution of coal. There is little published information of a precise nature on this point, and it is frequently assumed that coal may be heated to 250 deg. Cent., for purposes such as drying, without causing any modification in the coal substance. A general investigation of the behaviour of coal on heating is now being carried out at H.M. Fuel Research Station, and a report recently issued by H.M. Stationery Office deals with the results of experiments to determine the temperatures at which products of decomposition of various types of coal are first given off when the coal is heated. It is shown that when bituminous coals are heated oil fumes may appear at temperatures as low as 215 deg. Cent. The investigations are continuing and further reports will be issued in due course.

IN a paper entitled "The Design and Balancing of Three-Phase Low-tension Systems," read before the Junior Institution of Engineers on April 29th, Mr. W. Fordham Cooper put forward some theories for the design of cable networks in developing areas. He said that the deliberations recorded in his paper arose from his experiences during the last six months, when the heating load on the system with which he was concerned was increasing at an alarming rate. He had tried to find some definite basis on which to go forward, a basis which, although obtained from theories deduced from past experience, would be better than mere rule of thumb. Mr. Cooper had set out in detail in his paper particulars and calculations relating to the theories that he advanced. He said that many of the results which were given were admittedly tentative and awaited confirmation by experience, but he hoped that they would form a useful guide and stepping-stone to further advances.

SOME interesting records of the effect of the application of high temperatures on icebergs are to be found in an article by Professor H. T. Barnes in the *Marine Observer* for May. The rapid destruction of icebergs is best effected by the production of an internal disruptive force. In order to produce this force, Professor Barnes used thermit as the explosive, by which a very high temperature can be produced at a selected spot. His experiments were carried out in Notre Dame Bay, Newfoundland, on drifting bergs. One berg was about 100ft. above the water line and 500ft. long by as many wide. The berg appeared to be solid and fresh. A hundred pound charge was let into the ice in a 3ft. boring. The immediate effect of the explosion was much audible cracking and some visible disruption, but it was not until the next day and the day following that the full effect of the disruption was visible. Photographs show that within two days the berg, though still formidable, had been very much reduced in size. A smaller berg, about 100ft. in diameter, was practically destroyed within twenty-four hours by the use of two charges of thermit fired simultaneously.

Miscellanea.

IT has been decided to expend half a million sterling on the extension of the Capetown electricity scheme.

THE electrification of the Natal main line railway has resulted in an increase in capacity from 22,000 tons to 26,700 tons.

RECLAMATION of 8000 acres of swamp land along the Kootenay River, British Columbia, will be undertaken shortly by a company, incorporated for that purpose, operating from Creston.

AN expenditure of 189,600 dollars for the harbours and rivers of Prince Edward Island has been approved by the Dominion Government. The largest amount included 75,000 dollars for reconstruction of the railway wharf at Charlottetown.

THE North Australia Commission is inviting applications for the position of works engineer with headquarters for the present at Darwin. Civil engineering qualifications with a knowledge of road construction and water boring are required. The salary is £750 a year, with travelling allowances.

THE production of newsprint paper in Canada during 1926 was about 1,882,000 tons. Canada's newsprint mills started the present year with a rated capacity of 7350 tons per day, as compared with 5700 tons per day in 1926, in which year they produced over one-third of the world's newsprint. If present plans are realised the capacity will be increased a further 1200 tons in 1927.

PERHAPS the most important occurrence of vanadium minerals in South Africa is the Rhodesia Broken Hill mine, where they are found together with lead and zinc ores and other minor minerals. A recent report states that on the twenty-fifth level, for instance, good grade zinc ore, rich in vanadium, has been disclosed. The ore reserves show V_2O_5 values ranging from 0·4 to as much as 12 per cent.

DEFINITE arrangements have been made for close co-operation between the Canadian and United States Governments in carrying out investigations affecting the mineral industry in both countries. A conference was held at Ottawa recently between Canadian officials and representatives of the United States Bureau of Mines at which ways and means by which information can be pooled and present and future investigations co-ordinated were discussed.

ACCORDING to the *Industrial Australian*, Major de Havilland, while in Melbourne superintending the assembling of the first D.H. Moth aeroplane in Australia, said that the present price of the D.H. Moth is £825, but if there was a good demand he could turn them out for as little as £350. At present the price of the engine alone is £300, but if he was given the opportunity to produce about twenty aeroplanes a week he could bring down the price of the engine to £100, and the price of the complete aeroplane from £825 to £350, or even less.

IN order to render Chile independent of foreign markets for many manufacturing elements, including those used in the electrification of railways and the lighting services, a concession has been granted for a factory to manufacture copper wire. The necessary raw materials abound in Chile, and the factory will be able to produce copper wire of great purity. Insulated and non-insulated wire will be manufactured, as well as copper and brass plates and bars, tubing, wire ropes and concentric bare or insulated cables for high-power transmission. The factory is to contain rolling, tube-making, insulating and cutting machines, and at least one large wire-drawing machine.

AN extensive series of load tests is, according to the *Engineering News-Record*, to be carried out on a large concrete arch highway bridge in North Carolina during the coming summer and autumn. About the end of the current year the bridge, crossing the Yadkin River near Swift Island, will be permanently submerged by the backwater of a power dam. The bridge is quite new, having been built only six years ago. Since the submergence will render it valueless, the State Highway Department and the United States Bureau of Public Roads have decided to utilise it as a test object, if possible carrying the tests to destruction. The bridge comprises three open-spandrel arch spans of 146ft. 3in. clear, and a number of approach girders of 40ft. clear span. The arch spans consist each of two ribs 4ft. wide, 4ft. 6in. thick at springing and 2ft. 6in. at the crown.

THE Hume Reservoir, Australia, is, according to Mr. A. S. Kenyon, threatened by complete extinction within a comparatively few years if steps are not taken to maintain the integrity of the upper water catchments. Control of the catchments should, he says, be taken out of the hands of Government departments, and given to an independent body. The body would say what parts of the State should be reserved for water supply, what parts should be grazed, and what should be given over to agriculture. The position of the river catchments is becoming more and more dangerous. River erosion is a contributing cause, and floods have so increased that rich river flats, especially in the north of Victoria, are becoming swamps and morasses. Although great damage is done by bush fires, more damage is done to water catchments by indiscriminate grazing.

A MESSAGE from Mexico City states that a contract has been concluded for the construction of a highway between Mexico City and Acapulco, on the Pacific Coast, and the erection of piers for a bridge to cross the Rio Papagallo. A further contract provides for the reconstruction and prolongation of the section of the main roadway leading from Tierra Colorado to the same stream. This road, which will cross the entire State of Guerrero, was commenced several years ago, but abandoned for lack of funds. Its completion will prove of great value to this maritime State, which has a population of 650,000, by bridging the gap of seventeen miles from a point twenty-two miles out of Acapulco to the Rio Papagallo. The work will call for the construction of a large number of culverts and small bridges, and a considerable amount of expensive masonry work, such as retention walls which are necessary to keep the road open during the rainy season.

EXTENSIONS TO THE DEPTFORD POWER STATION

MR. G. W. PARTRIDGE, M. INST. C.E., LONDON, ENGINEER

(*For description see page* 598)

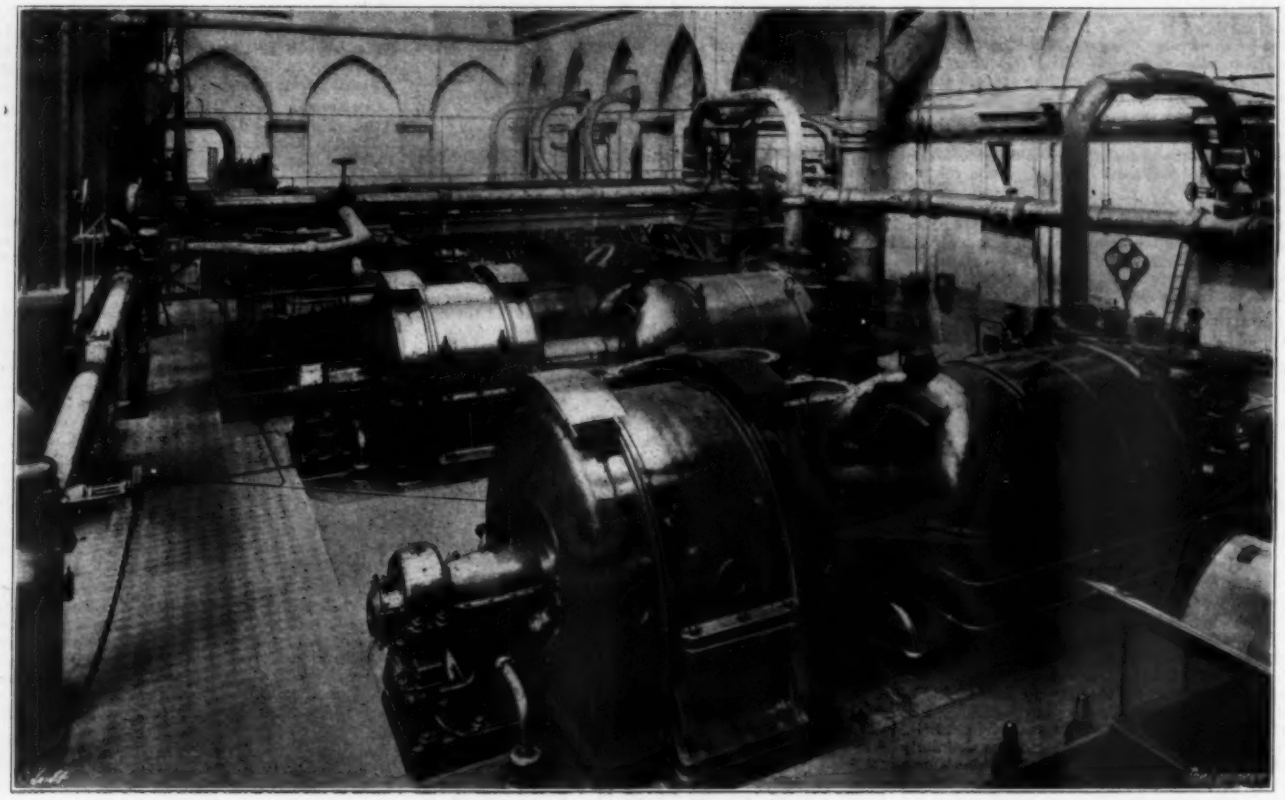


FIG. 5—BAY IN TURBINE HOUSE

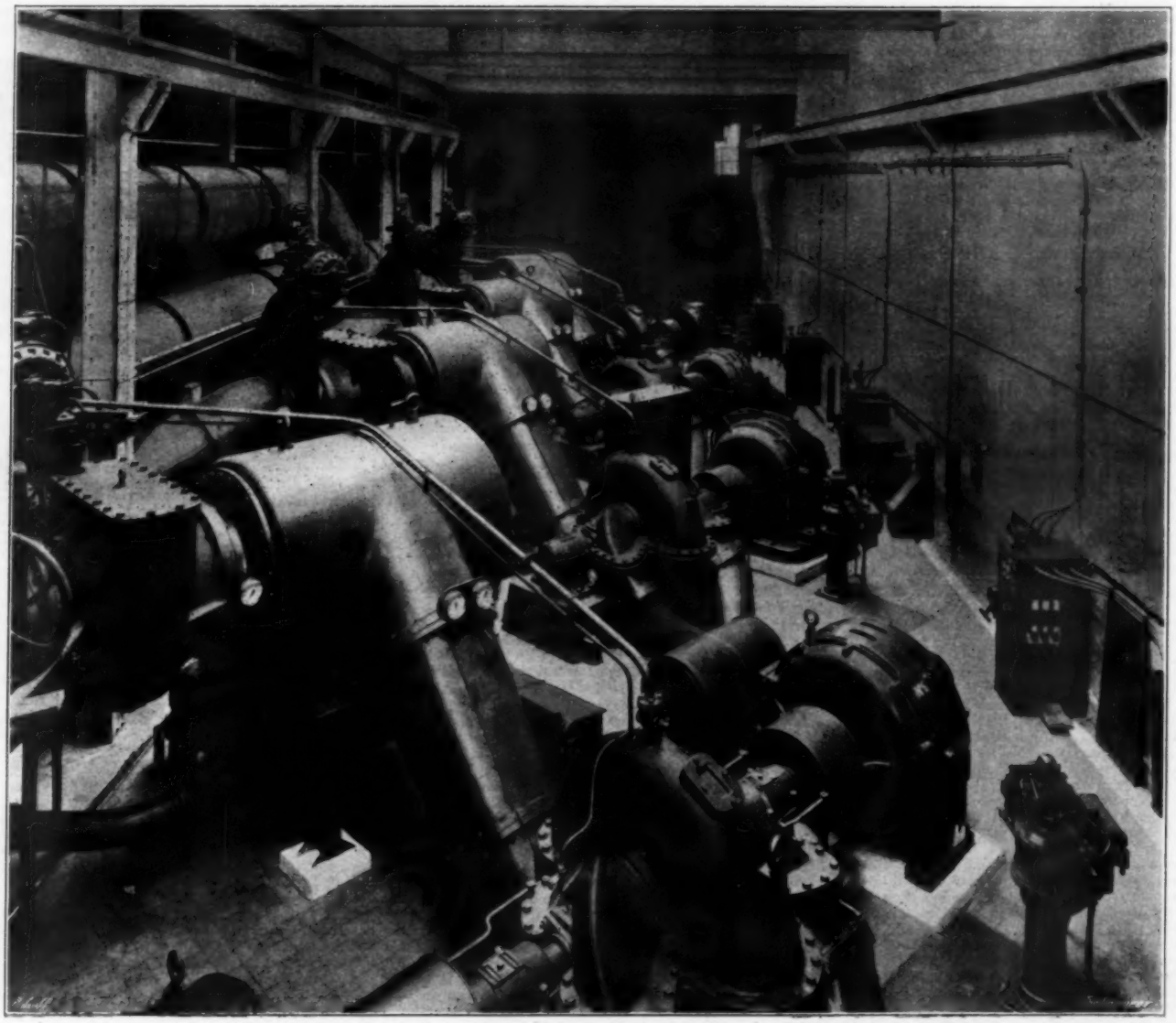


FIG. 6—CIRCULATING WATER PUMP HOUSE

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DEATH.

On May 27th, 1927, at a nursing home, following a severe operation, JOHN HAROLD WOODWARD, M. Inst. C.E., M.I.E.E. of 19, Hillsleigh-road, W. 8, and of 8, Queen Anne's Gate, S.W. 1.

THE ENGINEER.

JUNE 3, 1927.

The French Squadron at Portsmouth.

A FRENCH naval division, under the command of Rear-Admiral Pirot, arrived at Portsmouth on Monday and will remain until to-morrow (Saturday). The warmth of the welcome extended to it is proof of the cordial relations which unite the two countries. From the technical point of view the visit is rendered especially important by reason of the newness of the vessels composing the division. They typify almost the very latest practice in cruiser, flotilla leader, and destroyer design, all having been laid down since 1922, while the last was completed only a few months ago. France has just cause for pride in the fact that, at the present moment, no other Power could muster a corresponding force of equal modernity, speed, and fighting efficiency. Before we proceed to discuss the ships in question it may be interesting to recall the previous French naval visits to Portsmouth which have been paid in a spirit of peace and amity. The first of these visits took place in October, 1844, six years after the accession of Queen Victoria, when King Philippe returned the visit which the English Sovereign had made to his dominions in the preceding year. The squadron on that occasion consisted of paddle frigates, a type that was still something of a novelty. Very different were the vessels that arrived at Spithead in August, 1865, to commemorate half a century of unbroken peace between the two peoples. Of the French squadron of twelve ships, nine were ironclads of recent date, including the Gloire, famous as the first sea-going armour-plated ship, which the genius of Dupuy de Lôme had produced. An interval of twenty-six years elapsed before French men-of-war were again seen at Spithead. In August, 1891, Admiral Gervais arrived with a squadron which included the battleships Marengo and Marceau, and the armoured coast service ships Requin and Furieux. The formidable appearance of the latter pair so impressed some of our naval pundits that a demand was raised for building similar ships in this country. Fortunately, it went unheeded, for the French themselves were the first to acknowledge that in the case of these coast service units seaworthiness had been ruthlessly sacrificed to gun power and protection. The next visit occurred in August, 1905, to mark the establishment of the Entente Cordiale. Admiral Caillard came to Portsmouth with the Northern Squadron, comprising the battleships Masséna, Carnot, and Jauréguiberry, the coast service ships Bouvines, Tréhouart, and Henri IV., four armoured cruisers, and several light craft. A decade later the Jauréguiberry, as French flagship at the Dardanelles, was to cover herself with glory, fighting side by side with British forces in the heroic attack on the Narrows. Finally, in June, 1913, President Poincaré arrived at Spithead on board the battleship Courbet, escorted by cruisers and destroyers. The Courbet belonged to the first group of French Dreadnoughts, and her workmanlike design was much admired.

The ships now at Portsmouth are truly symbolic of current French naval doctrines. France has not entirely discarded the battleship, but in the very definite policy of sea defence which she is now pursuing the mastodon is cast for a minor *rôle*. Even the new cruisers, of which the Lamotte-Picquet and the Duguay-Trouin are specimens, were built in the teeth of opposition from the advanced school of French naval thought, which condemned them as needlessly large for the requirements of Mediterranean service. Swift vessels of the flotilla leader and destroyer types, armed with guns, torpedoes, and mines of unusual power; submarines of major and medium tonnage, and aircraft of every description—such are the instruments of combat upon which reliance is chiefly placed. France does not aspire to command oceans, but she is firmly determined to consolidate her communications with Northern Africa, which has become an indispensable reservoir of man power for the army. The present organisation of the fleet, the shipbuilding programmes now in hand, and the gradual development of bases along the Mediterranean littoral both south and north, all point unmistakeably to the Middle Sea as the main sphere of French naval interest. This being so, the secondary importance attached to battleships becomes intelligible, since even among British students there is a cleavage of opinion concerning the utility of these ships in comparatively restricted sea areas, such as the Mediterranean. The Duguay-Trouin and Lamotte-Picquet are uniform in all respects. Being of 7880 tons displacement, they may be compared with our cruisers of the "E" class, which, however, are of much earlier design. The French ships were planned for very high speeds, which have not yet been fully realised. They have geared turbines driving four screws, and eight Guyot oil-fired boilers. The machinery is designed for 100,000 S.H.P., which, it was expected, would give a speed of 34·5 knots, but although a considerable excess of power was developed on trials in each case, 33·6 knots is the highest speed attained up to the present by the Duguay-Trouin, which has proved slightly faster than her sisters. It is believed, however, that a marked improvement will result when the pitch of the propellers has been altered. Even as it is, these ships are among the swiftest cruisers in existence. Their lines are of rare beauty, and the profile is one of perfect symmetry. We have no hesitation in describing them as the handsomest ships of war which France has ever built. We believe them also to be thoroughly efficient in the military sense. True, they appear to be rather lightly armed for their displacement, mounting, as they do, only eight 6·1in. guns as the main armament. But these guns are housed in twin turrets, protected by armour which is at least splinter-proof, while the generous freeboard gives them a high command. They could probably be worked with greater effect in rough weather and would certainly be less liable to be put out of action than the guns mounted behind open shields in all but our very latest cruisers. Further, the new 6·1in. gun is stated to be extraordinarily powerful—more so, indeed, than the older 7·6in. mark. It has an extreme range of 22,000 m. and loads a shell which practical tests have shown to be uncommonly efficient. Incidentally, the turrets are understood to be gas-tight, an important feature in view of the possibilities of chemical warfare. Four 2·9in. A.A. guns are mounted on the shelter deck amidships, and there are four triple tubes, on upper deck mountings, for discharging the new 21·7in. torpedo. Two scouting aeroplanes are carried on launching catapults, and the powerful crane between the second funnel and the mainmast can be used for hoisting the machines inboard, as well as for handling the boats. In proportion to the displacement the maximum fuel capacity of 1000 tons seems scarcely adequate, though it suffices for a voyage of 4500 miles at 15 knots. We shall not be surprised if eventually the funnels are raised. At present they are very low, and at Spithead on Monday we noticed that with a following

wind the navigating bridge was half hidden in smoke from the forward funnel, which is no higher than the bridge screen. The protection of these ships is, we are assured, far superior to the ordinary standard for cruisers, particularly below water, where the subdivision is very complete. Vertical armour is worked in way of machinery spaces and there is good horizontal protection over these spaces and the magazines. All in all, the Duguay-Trouin and her consorts are magnificent exemplars of the modern light cruiser. It will be interesting to see whether our ships of the " B " class, approximately of the same tonnage, exhibit any features of marked superiority. It would, of course, be unfair to compare these French ships with the much larger vessels of the nominal 10,000-ton class, of which France, together with other Treaty Powers, has several under construction.

Three other units of the squadron, the flotilla leaders Jaguar, Chacal, and Tigre, have attracted much notice. Their formidable appearance is not belied by the details of their design. The displacement of 2362 tons exceeds that of our heaviest leaders by a substantial margin. They have a speed of 36½ to 37 knots, and a cruising endurance of 3500 miles. The armament comprises five 5·1in. guns on the centre line, two 2·9in. A.A. guns, and six 21·7in. tubes. The vessels are also fitted as minelayers. The 5·1in. gun is rather short, but it has a high elevation, probably 35 deg., and loads a shell with an exceptionally heavy bursting charge. It appears to be an admirable weapon for use against destroyers, and the weight of the projectile, about 60 lb. uncapped, should permit of rapid loading even in a seaway. These imposing flotilla leaders show evidence of the most careful design and workmanship, they are reported to be capital sea boats, and we hope at a future date to examine them in detail. The type is being further developed in France, for the Guépard and two other vessels now on the stocks are of 2650 tons and will carry five 5·5in. guns. Regarded purely as torpedo craft such vessels may seem inordinately large and costly; but if, as seems clear, they are designed primarily as scouts and patrol ships, with a special view to Mediterranean service, the design has obvious merits. The destroyers of the division, Bourrasque, Orage, and Ouragan, represent a modified version of the foregoing class. They are vessels of 1430 tons, with a speed of 33 knots, which was exceeded on trial, and have the same armament as the flotilla leaders, save that one 5·1in gun has been omitted. Possibly the armament is too heavy, as they are reported to be very lively in a seaway, though that is a fault common to most destroyers. All eight units of Admiral Pirot's division reflect the utmost credit on their designers and builders. France is to be felicitated on the possession of such splendid naval material, the multiplication of which will, without doubt, restore her to her former position as a naval Power of the first rank.

Old and New Atomic Theories.

IT is just sixty years ago since Professor Sir William Thomson, turning his thoughts from Atlantic cables to transcendental physics, came to the conclusion that the traditional conception of the atom as a hard, solid, inelastic particle of matter was too crude, even, as he put it, too monstrous, to merit continued acceptance. In common with other advanced philosophers, he was being forced by the rapid development of electrical science to seek an explanation of the fundamental constitution of matter in terms solely of energy and the ether. At an earlier date Helmholtz had made a mathematical study of vortex motion in a perfect, non-viscous fluid. In the characteristics of such motion as revealed by the German scientist, Thomson thought he saw the foundations of a new theory of atomic constitution. With customary forcefulness and iconoclastic joy he expounded his ideas on the subject to the Royal Society of Edinburgh in the spring of 1867. The ultimate particles of matter were, he contended, simply vortex rings in the ether. In a perfect fluid a vortex ring, once established, would, it had been shown, persist for all eternity. Therein he found the explanation of the indestructibility of matter. No action of the fluid itself could produce vortex motion within it. Therein he saw the reason for man's inability to create fresh matter. Two or more vortex rings, if they became linked, might change their relative attitudes, but they would remain linked to the end of time. Therein he discovered the cause for the existence of a series of different, intransmutable fundamental elements. Subsequently Thomson extended his mathematical investigations to a study of the mutual action between two vortex rings lying within range of each other with the object of explaining the nature of interatomic force and the formation of chemical compounds. The vortex ring theory was hailed at the time of its exposition as providing a startling, new basis for the whole of physical science. To-day it is no longer regarded as satisfactory. The mathematical studies on which the theory rested are being usefully applied in the investigation of the circulation round the wings of an aeroplane. But for their original purpose they have been discarded and almost forgotten. In the light of modern knowledge we have been compelled to adopt other views regarding the ultimate structure of matter. It has to be confessed that these views are much more complicated, much less definite, much harder to grasp and, when grasped, much less satisfying than those which Sir William Thomson laid before his audience in Edinburgh sixty years ago.

Two main factors led to the demise of the vortex ring theory. Since Kelvin's time the disintegration of the atom has become an established fact of common laboratory experience. In face of that phenomenon we cannot obviously adhere to a theory which postulates the eternal impossibility of one element changing into another. Secondly, the vortex ring theory left the electrification of matter or the conduction of electricity by matter as unexplained, as did the traditional atomic theory which it was to replace. It is in agreement with modern views only in so far as it takes matter to be fundamentally a manifestation of energy in the ether. According to current doctrine the atom is something like a miniature solar system. Round a positively charged nucleus there circulates a series of negatively charged electrons. The atomic planets, the electrons, are, however, unlike the real planets in that they are all of the same mass and in that they can follow a certain restricted number of different paths from one to the other of which they can jump suddenly, each jump involving the emission or absorption of a quantum of energy. In the hydrogen atom one electron is supposed to circulate round the nucleus. In the helium atom there are supposed to be two electrons, and so on up to uranium, the atom of which is conceived to possess ninety-two electrons. This theory, originated by Moseley and developed by Bohr and others, is now widely accepted and has been used to explain many diverse physical phenomena. Yet to many of those who have not become submerged in its mathematical intricacies it must appear to consist of transferring to the nucleus all, or nearly all, the unsolved mysteries which Lord Kelvin found the traditional conception of the atom incapable of explaining. The electron conception provides an explanation of numerous phenomena of an electrical nature, but the clarity obtained, it is to be feared, is achieved at the expense of adding to the mystery of the nucleus. The knowledge boasted of the electron is apt to make a simple student overlook the ignorance which is admitted concerning the nucleus or lead him to accept that ignorance as something which future discovery will make good rather than to criticise it as a possible weakness in the whole theory. The concentration of attention on the electron and on the explanation of electrical phenomena has obscured the fact that there are other phenomena which cannot be explained in terms of electrons and which, if we seek to explain them in terms of the nuclei, compel us to endow these constituents with characteristics as complex as those ascribed to the electrons are simple. It is impossible, for example, to explain the varying atomic weights of the elements in terms of electrons. In the first place, the atomic weights, when arranged in ascending order, do not increase by constant amounts, but quite irregularly by anything from 0·16 to 5·26. Clearly, therefore, the difference of the atomic weights is not to be explained by the progressive addition of one electron at a time to some original nucleus. Secondly, it is mathematically impossible that the addition of 91 electrons to the single electron and nucleus of the hydrogen atom could give us an element of atomic weight greater than 92, let alone uranium with its atomic weight of 238. There seems no escape from the conclusion that the number of electrons in an atom has little, if anything, to do with the determination of its atomic weight and that the prime factor determining that weight is the nucleus. The weight assigned to an electron is about $^1/_{1800}$ the weight of an atom of hydrogen; the 92 electrons in the atom of uranium can therefore account for only about 0·02 per cent. of the atomic weight of that element. Since the atomic weights are determined almost entirely by the weights of the nuclei and since the atomic weights progress by widely varying amounts, we stand committed to believe that the nuclei of the different elements, unlike the electrons, are not all of the same kind. Each element has its own particular kind of nucleus, just as each element used to be supposed to have its own particular kind of indivisible atom. The transmutation of one element into another, as exhibited by the radio-active substances, can only proceed by way of the disintegration of the nucleus and its assumption of the form characteristic of the nucleus of the new element. The escape of electrons may be an accompaniment of the process, but it is not the essential feature of it. The fact that the nucleus can disintegrate implies that it has a structure. It would be " crude and even monstrous " to suppose otherwise. But the nature of that structure is to-day as mysterious as was the structure of the atom before the conception of electrons and nuclei was introduced. The atomic weights—in effect the nuclear weights—contain no common factor so far as the limits to which they have been determined permit the point to be examined. The definite establishment of the absence of such a factor would, interpreted in the mildest way, imply that the nuclear structure, far from being simple, is a complex grouping of varying numbers of dissimilar sub-bodies.

The simple conception of matter as composed of equal amounts of positive and negative electricity satisfies our primitive feelings. The experimental detection of the negative particles of electricity, the electrons, and the discovery that all electrons, from whatever element they emanate, have the same apparent size, the same apparent mass, and the same apparent electrical charge seems to carry on the simplicity of the fundamental conception. That simplicity is, however, as we have sought to show, obtained at the expense of apparently great complexity in the positively charged particles or nuclei, of crowding on to the nuclei all the mysteries except the comparatively few which the existence of the electrons can be made to explain. It cannot be claimed by anyone that the researches and discoveries of recent years have simplified the problem of explaining the constitution of matter. To the student, if not to the expert physicist, each additional fact established, each fresh conception advanced, seems only to increase the complexity of the problem and to render more remote the possibility of reaching a reasonably simple and satisfactory solution of it. One is tempted at times to wonder whether the modern conception of the atom and its subdivisions will not eventually perish of complexity, just as in the opinion of many physicists the conception of an all-pervading ether should be allowed to die because of the complex and often contradictory characteristics with which the progress of scientific discovery has compelled us to endow it. Our leading physicists tell us that their ignorance concerning the characteristics of the atomic nucleus springs from the fact that it is much more difficult to get at than the electrons. That statement may be true on the experimental side, but it is not satisfying as a reason for ignoring the logical implications concerning the nucleus which can be drawn from the data already established about the electron. Is it possible that scientific obscurantism has played a part in the matter, that the study of the nucleus has been neglected because of an apprehension that the results of such study might react disastrously on the theory of the electron?

BOOKS RECEIVED.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. March, 1927. Paris: The Office of the Society, 44, Rue de Rennes.

The Port of Gothenburg Year Book, 1927. By Sixten Prytz. London: The Swedish Consulate-General, 329, High Holborn, W.C. 1.

Movable Bridges: Vol. II., Machinery. By O. E. Hovey. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 30s. net.

Central Station Voltages and Charges Throughout the United Kingdom, 1927. London: S. Rentell and Co., Ltd., 36, Maiden-lane, W.C. 2. Price 1s. net.

Zur Frage des Schiffswiderstandes. By Ch. Doyère. Translated from the French by Walther Meinenreis. Berlin: Julius Springer, Linkstrasse 23–24, W. 9. Price 7·50 marks.

Catalogue of the Collections in the Science Museum. Land Transport: No. IV., Railway Construction and Working. Compiled by E. A. Forward. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 3d. net.

Notes on the Preparation of Railway Projects. By H. L. Glass, Indian Railway Service of Engineers, being Technical Paper No. 256, and supplementary to the " Rules for the Preparation of Railway Projects (revised 1926) " Calcutta: Government of India, Central Publication Branch, 1927. Price 6d.

Incorporated Municipal Electrical Association.

No. I.

THE annual convention of the Incorporated Municipal Electrical Association is being held this year at Buxton, the president being Mr. R. W. L. Phillips, engineer and manager of the Bedford Electricity Works. It had been hoped that the common custom of holding the convention in the town of the president would have been followed this year, but the attendances at I.M.E.A. conventions have swollen to such considerable proportions during recent years that the Bedford hotel accommodation was found to be quite unequal to the task of housing the 900 or more delegates and visitors, which now appears to be the average attendance. Thus, as has had to be done on some previous occasions, a more suitable place from the accommodation point of view had to be sought and Buxton was selected. Monday, May 30th, was the day of arrival in Buxton of those taking part in the convention, and the Convention proper opened on Tuesday morning, May 31st, when there was a civic welcome by the Mayor of Buxton in the Opera House in the Pavilion Gardens.

The first real business of the convention was the presidential address by Mr. Phillips, who, after some well-deserved comment as to the satisfactory manner in which municipal electricity supply has been developed in this country at a cost which at least compares favourably with that of other undertakings, passed on to a general consideration of electrical legislation as affected by the Government Act of 1926. Special mention was made of the report of the Advisory Committee appointed by the Electricity Commissioners on Domestic Supplies of Electricity and Methods of Charge, concerning which the fear was expressed that that report had been overlooked in the more general interest taken in the proceedings which led up to the passing of the Act of 1926, though some of the points brought out in the report of the Committee had embodied in the 1926 Act. For instance, Section 48, which authorises all municipalities owning electricity undertakings to sell electric fittings and apparatus, also authorises by implication—there is the authority of the Minister of Transport for this statement—the provision of showrooms and a reasonable expenditure on advertising and other forms of publicity work. It was thought by the President that the most important matter that the Advisory Committee considered was the question of a suitable tariff for universal adoption. He was disappointed, in view of the abundance of evidence taken on the subject, that the Committee was unable to recommend any particular form of tariff for exclusive use, without offering an alternative flat rate. As a matter of fact, the Advisory Committee examined in detail some thirteen different methods now in use, but was unable to select one as being sufficiently perfect for universal use. Having regard to the fact that the Electricity Commissioners now have power to fix a tariff for the country, Mr. Phillips thought that it was time that the industry made up its mind what it wanted. It seemed to him that the evidence in the report, if anything, leant towards the adoption of floor area as possibly the favourite method. Alternatively, another method which merited consideration was to assess the fixed charge on the size of the meter installed, such charge to get gradually smaller as the size of the meter increased. It was also suggested that a decreasing charge per unit might also be made, in order to stimulate consumption. The hope was expressed that a committee would be formed by the I.M.E.A., either alone or jointly with other bodies, to continue the efforts towards determining a general tariff from the advanced point reached by the Advisory Committee.

Mr. Phillips said that, speaking generally, whilst there were questions affecting the industry which could only be settled by new legislation, there were others that could best be dealt with by conference within the industry. For instance, in his view, most of the matters touching upon overhead lines—this question was dealt with at some length in the paper by Mr. W. C. Bexon which followed the presidential address—could possibly be settled by conference between the Electricity Commissioners, the Postmaster-General, and the supply authorities. Mr. Phillips said that he had reason to believe that such a conference could easily be arranged by application to the Electricity Commissioners, and he urged that it should be taken in hand forthwith.

Another matter dealt with and considered of great importance to the industry was the terms and conditions on which a bulk supply would be available to those undertakings which were to cease generating. The I.M.E.A. had a Bulk Supply Committee, and his view was that it was the duty of that Committee to get to work as quickly as possible and take the necessary steps to formulate a standard procedure. A false step at this moment might lead to a state of affairs which might seriously cripple the development of electricity supply, particularly when it was necessary to offer low or special rates to consumers to suit special conditions. The information already in the possession of the Bulk Supply Committee was only useful in a negative sense, as the terms and conditions examined varied, both in method and magnitude, in different undertakings, to such an extent as to render analysis an impossibility. Hence the need for efforts to arrive at some standard method, in view of the number of stations which would cease to generate under the new conditions shortly to come about.

DISTRIBUTION OVER AN EXTENSIVE AREA.

Following the presidential address, Mr. W. C. Bexon, Electrical Engineer to the Ayrshire Electricity Board, read a paper entitled "Methods and Capital Costs of Distribution over an Extensive Area." The paper dealt with the conditions likely to arise in the case of an electricity works supplying its own particular township, whilst within a radius of 20 or 25 miles there were other towns having populations below 11,000 and 30,000 which had no electricity supply. The intervening country between the various towns might be sparsely populated, but there might be a number of villages and an occasional large works, also a few collieries. In short, it was the type of area covered by the Ayrshire Electricity Board, which had an extent of about 100 square miles. Details were given in the paper of (*a*) constructional and capital costs of the E.H.T. transmission lines, (*b*) construction and capital costs of tapping E.H.T. transmission lines, (*c*) construction and capital costs of open-air static sub-stations, (*d*) systems and costs of underground distribution, (*e*) construction and costs of overhead low-tension distribution, (*f*) regulation and pressure on long-distance transmission lines.

A strong feature was made in the paper of the difficulties encountered, when endeavouring to erect overhead transmission lines, from farmers and landowners, and also from the Post Office authorities, the view being expressed that the Electricity Act of 1926 had not improved the position in that respect. It was contended that the present regulations of the Electricity Commissioners almost put overhead distribution out of court in some small villages and that some of the conditions stipulated in the Electricity Commissioners' Regulations, 1923, were unnecessary, particularly Clause 13. The following suggestions concerning overhead lines and other outstanding obstacles to the free development of electricity supply were therefore made :—

(*a*) Statutory rights should be given to Electricity Authorities to erect transmission lines through agricultural country, after submitting plans to the Electricity Commissioners. The present method of giving notice, and later having an inquiry, causes considerable delay and should be cancelled.

(*b*) A statutory wayleave rental of 1s. per pole per annum to the landlord should be made compulsory throughout the country.

(*c*) A statutory wayleave rental of 1s. per pole per annum in grass, 1s. 6d. in corn, and 2s. 6d. in green crop should be given to the tenant.

(*d*) Statutory powers should be given to Electricity Authorities to erect section boxes and kiosks in public thoroughfares.

(*e*) Any expenses incurred by an Electricity Authority in removing works, viz., underground cables, transmission lines, section boxes, &c., on account of the alteration to a street, &c., by the Local Authority should be paid to the Electricity Authority by the Local Authority.

(*f*) Electricity Authorities should be relieved of all rates and taxes on transmission lines in areas from which no revenue is derived.

(*g*) The rule of paying to the Post Office Authority a proportion of the cost of laying their works underground when they are second comers should be cancelled.

(*h*) The Post Office condition that power lines must be not less than a pole and a-half distance from telegraph lines should be cancelled.

(*i*) Easier facilities should be given to Electricity Authorities to erect poles along the roadside.

In connection with E.H.T. transmission it was observed that underground cables with pressures of 33,000 volts and above had yet to be proved reliable, and from data available it appeared that voltages of 22,000 to 25,000 had been shown to be the most economical for a radius of 25 miles, and a voltage of 11,000 for a radius of 10 miles, which bore out the old rule of 1000 volts per mile. Cables for those working pressures had proved reliable.

Speaking of defective insulators on overhead lines, it was stated that the failures of insulators would be comparatively few provided that the insulators were manufactured in this country and recommended by the manufacturers for the specific duties.

One of the greatest weaknesses in overhead lines was the trifurcating boxes, which were usually erected at the top of the pole, and it was impossible to inspect them until the transmission line had been made dead. If a fault occurred on a six-wire line then both lines had to be shut down until the box was repaired. The author said that, in conjunction with one of his assistants, he had designed a box which it was claimed had minimised those troubles. Instead of the dividing box being erected at the top of the pole, a small sealing end box, which terminated the underground cable, was erected at a height of 10ft. to 12ft. up the pole. Special leads were run from this sealing box to the top of the pole and the cables terminated in a porcelain sealing end. This type of box had been in use for four years and no breakdown had yet occurred. The boxes could be inspected easily and should one break down it could be repaired without curtailing the whole of the supply on the six-line wire.

The paper contained a large amount of data relating to different forms of pole line construction and supply to various size towns and villages, and indicated the best and most economical methods to be adopted, but running through it all was the complaint of the difficulties encountered due to the demands of the landowner, the farmer, the Post Office, and indeed anybody who was entitled to have anything at all to say concerning the erection of an overhead line.

Mr. J. W. Burr, Electrical Engineer at Swansea, opened the discussion on Mr. Bexon's paper, and emphasised the need for ensuring continuity of supply in rural and semi-rural districts irrespective of cost. He recalled that electrical development had been retarded in some areas for many years because there had been a breakdown on one occasion for a short period. Speaking of such breakdowns, he said that the user blamed the manufacturers of the cable and the manufacturers blamed the users, alleging that there must be resonance in the line or something of that sort. Experiments were to be carried out at Swansea, which would last for twelve months, with the object of finding out exactly where the trouble was. Personally, he did not care whether it was proved to be due to resonance in the line or faulty cable manufacture, so long as the real cause of the trouble was ascertained. Referring to the supply to farms, he did not think that it was likely to prove a paying proposition to the supply undertaking, and suggested that the farmers should form local companies for distribution among themselves. Many of the Electricity Commissioners' regulations could be modified without risk of danger to the public.

Mr. A. W. Turnbull, Electrical Engineer to the Aylesbury Urban District Council, which has been developing the rural area in its vicinity, described a new construction of pole line which he had devised with a view to meeting objections to pole lines from the æsthetic point of view. In it the cable is drawn through the pole and not placed on cross arms, and the insulators were so placed as to be less obtrusive than with the normal type of construction. Mr. Turnbull also said that he was using galvanised steel wire for overhead cables transmitting at 11,000 volts. The new pole line construction had been inspected and approved by the Electricity Commissioners.

Captain J. M. Donaldson, Chief Engineer to the North Metropolitan Electric Power Supply Company, also spoke of the difficulties experienced in connection with overhead line construction, and suggested the drawing up of a standard form of agreement with a standard rental for all normal cases. He also suggested that farmers and landowners would be more impressed if the Ministry of Transport were to issue a short official explanation of the rights of supply authorities. If those steps were taken he anticipated that much less trouble would be experienced in the future with regard to wayleaves. He also expressed the view that some of the existing regulations were unnecessary and others incapable of application.

Mr. T. Hall, Electrical Engineer to the Burton-on-Trent Corporation, commented on the trouble caused by boys throwing stones at porcelain insulators and breaking them. Had anybody found a remedy for that? He asked those with information available concerning overhead lines generally to communicate it to Mr. S. E. Britton, Electrical Engineer to the Chester Corporation and Chairman of the I.M.E.A. Committee dealing with the revision of the regulations relating to overhead lines.

Mr. R. Borlase Matthews said that, whereas two years ago there were 200 farmers in Great Britain taking a supply of electricity, there are now 700. Although that was an improvement, it compared with one million farmers using electricity in the rest of the world. The average demand from farms in Great Britain was about one-eighth that on the Continent. Therefore it was necessary to install experimental electrical farms to educate the farmers to an appreciation of what electricity could do on the farm. The British Electrical Development Association intended to have an electrically operated farm in connection with the Royal Agricultural Show at Newport (Mon.) in July. Referring to transformer houses, he suggested that they should be built so that a man could not get inside them, as otherwise they came under the Factory Acts inspection, and he preferred to work with as little Government interference as possible.

Alderman Sowter, Chairman of the Bedford Electricity Committee, and a railway signal engineer, said that many of the difficulties encountered with railway companies when it was desired to cross their lines with power lines were due to the fact that the electrical departments in the past had been under the control of the civil engineer's department, but a change was coming about in that respect. As to insulators, for their telephone and telegraph lines, the railway companies had tried all kinds, and whilst most of them were not proof against stone throwing, the unbreakable kinds failed from the electrical point of view where high voltages were concerned.

Mr. Bexon briefly replied to the discussion and the convention adjourned until the next day, Wednesday, June 1st.

In the afternoon there was an inspection of a small electrical exhibition in the Pavilion corridors, at which thirty-seven firms exhibited. The exhibits were mainly confined to the smaller classes of appliances, including general domestic apparatus, portable electric tools, motors, street lighting fittings, X-ray apparatus, electric storage cisterns, electric cooking apparatus, time and other switches. The only heavy type of apparatus was a 30-cwt. low-loading refuse collection vehicle.

(*To be continued.*)

Thornton and Cleveleys' Electricity Scheme.

THE supply of electricity to scattered areas is a matter that is now demanding considerable attention, and details of recent schemes can scarcely fail to interest engineers who may have to design distribution systems suitable for such areas. Thornton and Cleveleys, two health resorts comprised within the urban district of Thornton and situated 5 miles from Blackpool, have recently been provided with an electricity supply which serves for lighting a number of modern houses by means of underground cables. While every endeavour had to be made to reduce the distribution costs, owing in a large measure to the character of the houses, and the general surroundings, it was deemed inadvisable to use overhead conductors.

Under the care of an enterprising Urban Council and vigilant officials the district is growing at a rapid pace, and recently an Improvement Act was obtained which confers upon the inhabitants considerable powers for carrying out public improvements. With an eye on the future a town-planning scheme, under which there is to be no crowding of dwellings, has been adopted. The scheme provides for 100 acres with houses not to exceed eight to the acre, 604 acres with twelve houses to the acre, and 154 acres with three houses to the acre. It will be seen, therefore, that for the most part the development of the district is being carried out on spacious lines, with ample breathing space for those who may visit or reside on this portion of the Fylde seaboard. In addition to the present amenities, the Act provides for a promenade at Cleveleys, new arterial roads, the widening of existing roads, a ferry across the river to Wardleys, and a footpath on the river bank.

The district has a good supply of gas, which is obtained from the Urban Council's works, and, as already stated, a supply of electricity has now been provided. An Electricity Order was obtained as far back as 1914, but it was not until 1925 that the scheme began to materialise. In that year Mr. W. P. Lilwall, Electrical Engineer to the Fleetwood U.D.C., was asked to draw up a suitable scheme for providing electricity for lighting and other purposes, and, as the area is a very scattered one, he designed a high-tension network with transformer kiosks and a low-tension distribution system fed from the low-tension side of the transformers contained in the kiosks. The scheme will readily be understood from the drawings Figs. 1 2 and 3, which show the general lay-out of cables in Thornton and Cleveleys and the lay-out of the cables around the kiosks. A bulk supply is obtained from Blackpool, and, as shown in Fig. 1, a 0·06 square inch 6600-volt interconnector runs from the Thornton Gate sub-station of the Blackpool Corporation to the first transformer kiosk associated with the Thornton scheme. Besides having a high-tension switch for the local transformer, this kiosk also contains a switch for controlling the whole of the high-tension network which is approximately 5000 yards long. Each of the five kiosks is also interconnected with the low-tension distributors so that any transformer can be disconnected without interrupting the supply, and in the event of the high-tension feeder between any two kiosks failing, it is possible to transform up and supply the kiosks beyond.

Cable laying was commenced by Henley's Telegraph Works Company at the beginning of March, 1926, and a supply was given over the whole area on August 13th. At the end of December there were 600 consumers and 100 services in new and unoccupied houses or for people who had not up to that time wired their houses. A record taken in November showed the maximum demand to be 104 kilowatts. The population is approximately 6500, and it was estimated that one-third of the houses would take a supply, an estimate that has proved to be justified.

The employment of the General Electric Company's transformer kiosk sub-stations, which are designed for high-tension installations in which the supply voltage must be transformed down for power and lighting purposes, is one of the most interesting features of the scheme. Kiosk sub-stations are rapidly superseding those constructed of brickwork, because they considerably reduce the capital outlay and superficial area required, which, naturally, results in a decreased cost of installing the networks. Kiosk sub-stations made by the General Electric Company are designed for pressures up to 6500 volts and for supply circuits having a maximum capacity of 300 kilovolt-ampères, although those employed on the schemes under consideration have considerably

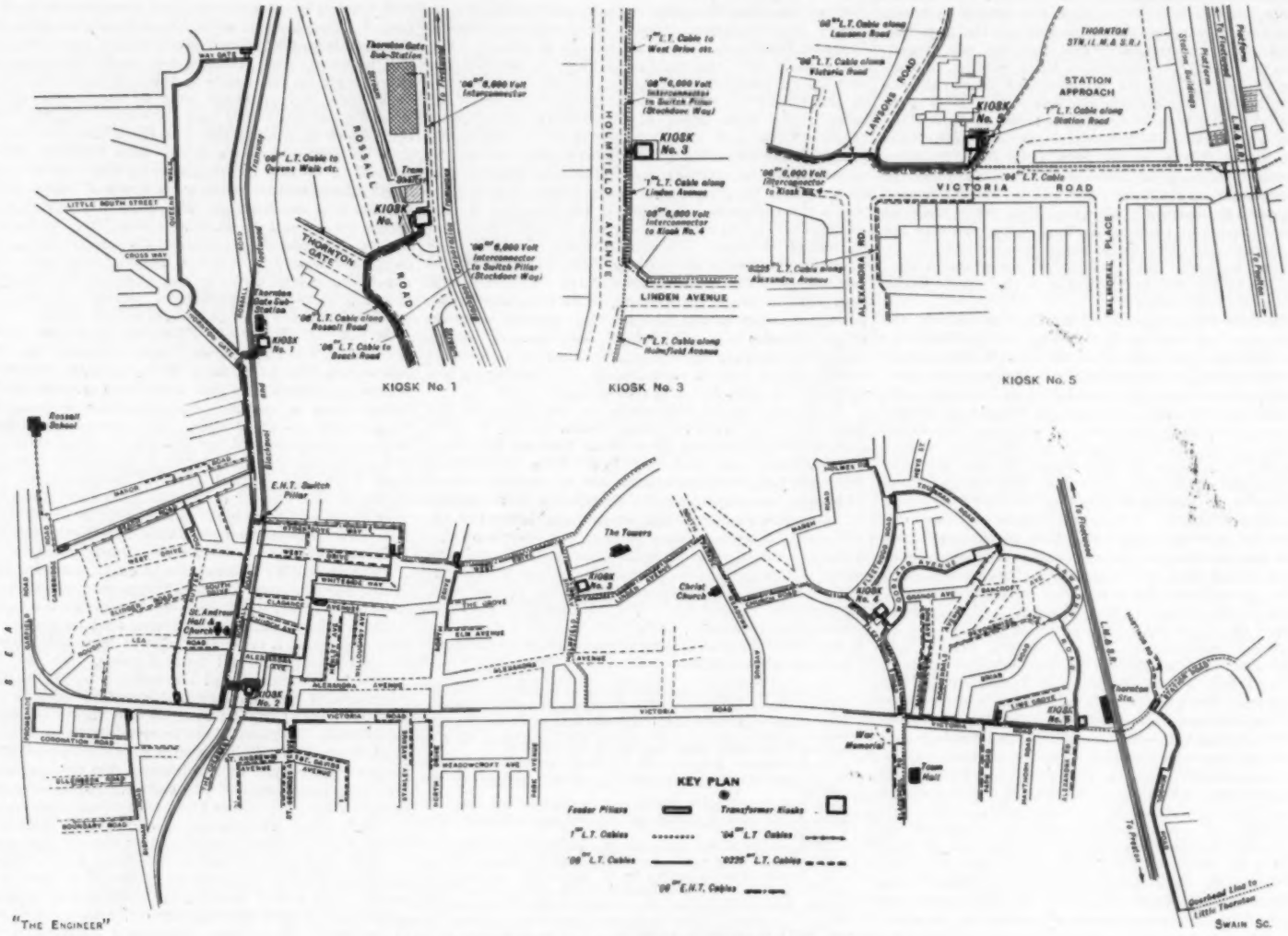


FIG. 1—ARRANGEMENT OF CABLES AND TRANSFORMER KIOSKS

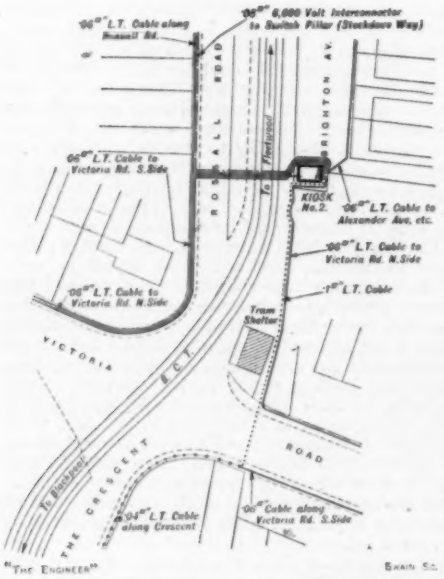


FIG. 2—ARRANGEMENT OF CABLES AROUND NO. 2 KIOSK

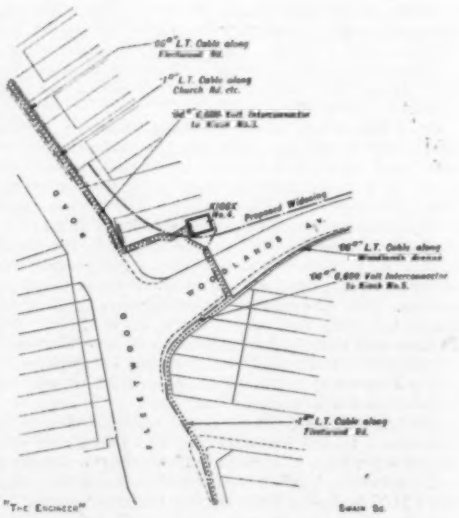


FIG. 3—ARRANGEMENT OF CABLES AROUND NO. 4 KIOSK

lower capacity. In all cases they are constructed of heavy gauge steel plate with a welded steel roof, and cast iron mouldings and cornice pieces ensure that the structure is absolutely waterproof. They are divided into three compartments and the transformer is accommodated in the middle section, whilst the high and low-tension switchgear is placed on either side. Steel doors give ready access to the transformer and high and low-tension gear, and as the high-tension cubicles have separate padlocks, on opening the outer door on the high-tension side, the oil circuit breaker shown in Fig. 8 is the only accessible portion of the apparatus. Only when the padlocks on the cubicles have been removed is it possible to obtain access to the live portion of the high-tension switchgear.

The high-tension apparatus consists of an oil circuit breaker having the necessary overload and leakage trip coils and the current transformers for use with them, it being possible completely to isolate the oil circuit breaker from the high-tension supply by means of isolating links. On the low-tension side the distribution circuits consist of G.E.C. unit type of "Handguard" fuses mounted on bakelite tubes, ammeters being provided if required. For use with all the cables, cable boxes and efficient sealing devices are provided. A typical diagram of connections for the General Electric Company's transformer kiosks is shown in Fig. 5, which also shows the general arrangement of the high and low-tension gear. A kiosk with the doors open on the low-tension side is shown in Fig. 6 and a kiosk erected at the side of a house is shown in Fig. 7. Details of a complete kiosk are shown in Fig. 4.

For these transformer kiosk sub-stations various advantages are claimed, such as (*a*) low capital cost compared with that of a brickwork sub-station—the superficial area is approximately 50 per cent. of that required by a brickwork structure for a given output; (*b*) no foundations other than a concrete slab; (*c*) absolutely weatherproof construction yet good ventilation, the normal temperature of the transformers preventing condensation inside the kiosk. While all parts of the equipment are readily accessible, the whole of the switchgear is self-contained and mounted inside the sub-station without being supported on the sides of the kiosk. The high-tension switchgear is enclosed by steel plate and the low-ten-

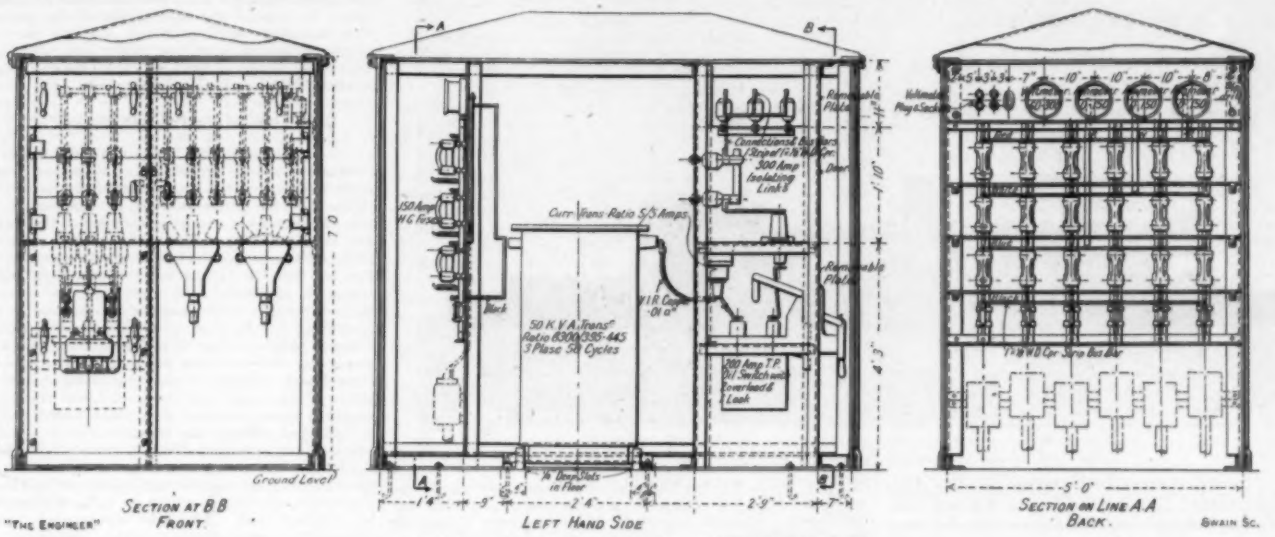


FIG. 4—ARRANGEMENT OF 50 K.V.A. TRANSFORMER KIOSK

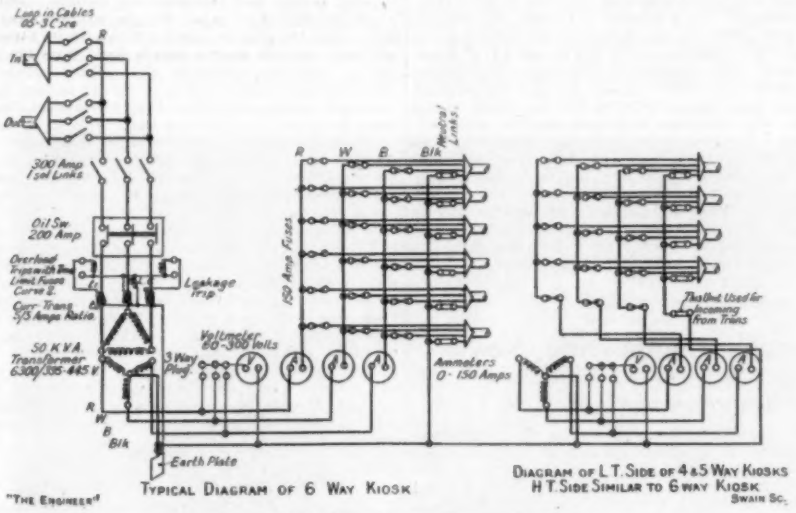

Loop in Cables 65-3 Core
In
Out
300 Amp Fuse Links
Oil Sw. 200 Amp
Overload Trip with Time Limit Fuses Curve E
Leakage Trip
Curr. Trans. 5/5 Amps Ratio
50 K.V.A. Transformer 6300/335-445 V
3 Way Plug
Voltmeter 60-300 Volts
150 Amp Fuses
Ammeters 0-150 Amps
Earth Plate
Typical Diagram of 6 Way Kiosk
Diagram of L.T. Side of 4 & 5 Way Kiosks
H.T. Side Similar to 6 Way Kiosk
"The Engineer"
Swain Sc.

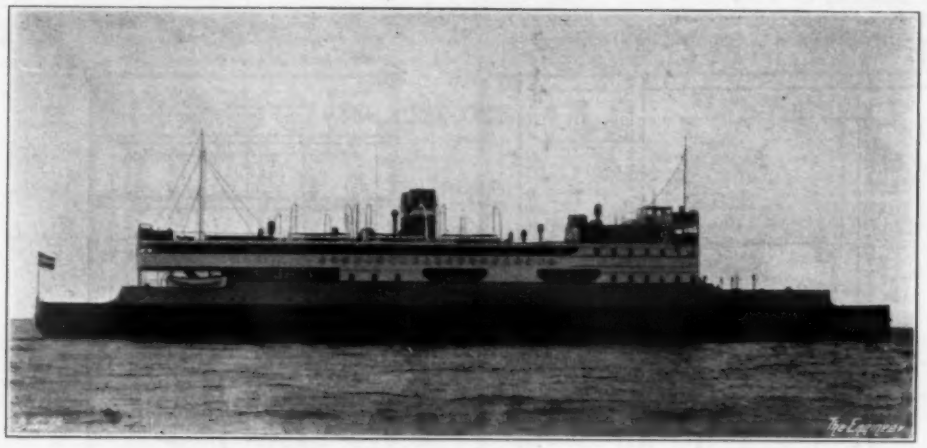
FIG. 5—DIAGRAMS OF KIOSK CONNECTIONS

FIG. 8—H.T. SIDE OF KIOSK

FIG. 6—L.T. SIDE OF KIOSK

FIG. 7—KIOSK ERECTED AT THE SIDE OF A HOUSE

THE DANISH MOTOR TRAIN FERRY KORSOR



sion gear is mounted on bakelite tubes or slate slabs to suit requirements. The kiosks can be shipped complete ready for bolting down to a concrete slab and can be put into service in a few days, and, if necessary, they can be connected to a ring main system. Provision can be made for future extensions, and when extensions are required the kiosks can be moved from one place to another. For lighting these kiosks substations bulkhead fittings are provided.

For permission to publish particulars of the scheme we are indebted to the Thornton District Council. We have also to acknowledge the assistance of Mr. W. P. Lilwall, the consulting engineer, and Mr. A. G. Cooper, the Council's engineer, who has courteously supplied us with technical data.

A Large Oil-Engine-Propelled Train Ferry.

THE new motor train ferry Korsor, which has been built by the Elsinore Shipbuilding and Engineering Company, at Elsinore, and engined by Burmeister and Wain, Ltd., of Copenhagen, and was recently put to work on the ferry route between Zealand and Fyen, is claimed to be the largest vessel of its kind in the world. She has a length of 315ft., with a breadth over fenders of about 58ft. and depth of a little over 13ft. Her propelling machinery comprises two sets of eight-cylinder, single-acting B. and W. type engines, working on the four-stroke cycle, and designed for a total output of 4000 I.H.P. when running at 200 r.p.m., giving the vessel a designed speed of 15½ knots on a draught of about 13ft. The two engines are built as port and starboard units, with the manœuvring controls facing one another at the centre of the engine. The engines are of the high-speed trunk-piston pattern, similar to those that were installed in the motor ship Parkeston—which was described in our issues of August 14th and 21st, 1925. They are fitted with governors and are able to run evenly at the low speed of 45 r.p.m.

The auxiliary machinery includes three 100 K.W. and one 50 K.W. oil-engine-driven generating sets, which are arranged athwartships at the forward end of the engine-room; each set is provided with a direct-driven three-stage air compressor, designed for an adjustable output, which enables it either to supply injection air for the generator engine, or to act as a reserve unit for the main engine compressors on the manœuvring compressors. The pumps are grouped near the back platforms of the main engines, and include duplicate sets of electrically-driven cooling water and lubricating oil pumps. There are two electrically-driven fuel oil pumps and two sets of twin plunger pumps for bilge and sanitary service.

In a separate boiler-room, which is arranged abaft of the main engine-room, there are two sets of water-tube boilers, which are arranged to burn oil fuel and also to make use of the heat in the exhaust gases. Provision is made to heat the exhaust gas spaces so that no condensation with accompanying tendency to corrosion can take place.

The Korsor, which was built in accordance with the rules of the Bureau Veritas, has a flush main deck, into the wooden deck of which the three rail tracks are recessed, so that motor cars can also be carried. The total rail length is about 790ft., which is larger than that of a corresponding steam ferry owing largely to the absence of uptakes. The total gain in accommodate space which has been made possible by using oil engines is assessed by the builders at 25 per cent. Above this main deck is a promenade deck some 197ft. in length, which runs the full breadth of the vessel. The ship is designed to carry a wagon load of 500 tons along with 1500 passengers There is accommodation for first, second and third-class passengers arranged on the promenade deck, the forward part of which is totally enclosed and fitted with large square windows.

The vessel is provided with four trimming tanks, with a total capacity of 400 tons, and four wing tanks, holding 160 tons of water. A large vertical electrically-driven centrifugal pump is provided, so that the trimming operation can be quickly carried out by transferring water to or from the various tanks, thereby facilitating the wagon shunting operations. The Korsor is fitted with watertight bulkheads and life-saving equipment, and the deck machinery is electrically operated.

Owing to the ferry being employed on both day and night service, and to sleeping cars being carried, it was necessary to take special precautions to avoid any machinery vibration, which we learn has been done with every satisfaction.

At the speed trial of the vessel, which was held early in May, before the vessel was completely fitted out, a maximum speed of 15·51 knots was registered with the main engines developing 5100 I.H.P. at 191 r.p.m. On leaving Elsinore for Korsor on May 13th, two consumption trials were carried out. The first was a four-hour trial with the engines developing 3620 I.H.P., during which a fuel consumption of 141·5 grammes, or 0·312 lb. per I.H.P. hour was obtained. In a second trial with the engines developing 4160 I.H.P. for two hours, the fuel consumption recorded was 142·1 grammes, or 0·313 lb. per I.H.P. hour. During the trials each exhaust gas boiler gave evaporation of about 1320 lb. per hour of steam and the temperature of the exhaust gases was reduced to 250 deg. Cent. in the boilers. The ship was shown to possess excellent manœuvring qualities. The ferry between Zealand and Fyen was opened in the year 1883, when 132,492 passengers and 13,482 tons of goods were carried. The trade has rapidly increased, and in the year 1915–16 1,219,698 tons of goods were transported, while in 1920–1921 947,500 passengers were carried. The first ferries were paddle steamers, which were followed by screw vessels, to which fleet the newly completed motor train ferry Korsor has now been added.

American Engineering News.

Another High-pressure Locomotive.

As a result of the performance of the Horatio Allen locomotive of the Delaware and Hudson Railroad, carrying 350 lb. pressure and having a water-tube fire-box, that line has now put in service a similar engine but carrying 400 lb. pressure. It is named the John B. Jervis, after the first chief civil engineer of the line. It is a two-cylinder compound engine of the 2–8–0 class, with a tender carried on six-wheel bogies, the rear bogie having an auxiliary "booster" engine and two coupled axles. The fire-box has two top and two bottom drums, connected by curved tubes, and the former—30in. in diameter—extend nearly the full length of the boiler barrel, to which they are connected by pipes at their forward ends. The barrel is entirely filled with water, the steam space being in the 30in. drums above it.

Cylinders	22½in. by 30in. and 38½in. by 30in.
Driving wheels	4ft. 9in.
Weight on drivers	147 tons
Weight, total	168 tons
Wheel base, driving	18ft.
Wheel base, engine	29ft.
Wheel base, engine and tender	75ft.
Boiler barrel	5ft. 2in.
Fire tubes	No., 101; 2in.
Superheater tubes	No., 52; 5½in.
Length of tubes	15ft.
Fire-box	152in. by 78in.
Heating surface—	
Fire-box	1150 square feet
Arch tubes	67 square feet
Tubes	1904 square feet
Total evaporating	3121 square feet
Superheating surface	700 square feet
Grate area	82 square feet
Fire-box tubes	2in. and 2½in.
Tender, water capacity	16,000 gallons
Tender, fuel capacity	20 tons
Tender, weight loaded	150 tons

Power in the American Steel Industry.

The total power used by steel mills during 1926 was about 7 thousand million kilowatt-hours, of which 75 per cent. was generated in the mills and 25 per cent. was supplied from central stations. The motors aggregate 3,500,000 H.P., of which 36 per cent. are driven by purchased power. Future practice is expected to be towards steam-driven turbo-blowers and turbo-generators. Boiler plants will be developed to burn surplus blast-furnace gas, and where the gas supply is insufficient, pulverised coal can be used to advantage with the same boiler settings. In the case of steel plants having blast-furnaces, there is likely to be a tendency to connect them with central stations, so that excess power developed can be sold to the latter, or extra power purchased from them when needed by the mill. For steel mills without blast-furnaces, and having central stations within reach, it is considered that the purchase of power will be more economical than installing a power plant at the mill. With increasing wage rates and reductions in working hours, the great rise in labour cost has been more than offset by introducing machinery and speeding up existing equipment, thus requiring much more power. Under this development at one large plant, the production per man was increased 35 per cent. in ten years, in spite of the elimination of the twelve-hour day. The industry employs about 470,000 persons, with an aggregate annual wage and salary pay roll of £170,000,000. The consumption of steel *per capita* for the total population is about 930 lb.

Ventilation of the Oakland Tunnel.

In the 3550ft. highway tunnel under the harbour channel between Oakland and Alameda, California, the matter of ventilation was an important factor of the design, owing to the great number of automobiles and motor trucks comprising a large proportion of the traffic. Forcing air longitudinally through the tunnel as a conduit was undesirable, owing to the accumulating pollution towards the far end, the great volume and high velocity of air required, involving high cost, and the inconvenience of such a draught to passengers, in addition to its danger of spreading fire in case of accident. The tunnel being of circular section, there is a large hollow space beneath the roadway, and a ceiling forms a similar space under the tunnel arch or roof. In the ventilating system as adopted, fresh air is forced from each end into the lower space or conduit, which is closed at the mid-length of the tunnel by a bulkhead. From this conduit the air escapes through vertical ducts spaced 15ft. apart along each side of the roadway. The air current is upward and across the tunnel, the foul air passing through openings in the ceiling into the upper conduit, in which an induced draught is formed by exhaust fans. The inlet ducts open into expansion chambers having gratings which distribute the air and prevent unpleasant force or velocity of the escaping fresh air. In the same way the exhaust openings have adjustable gratings to regulate the escape of the foul air.

Improvements in Points and Crossings.

A recently published review of developments in railway points and crossings—or switches and frogs—concludes that there is not in sight any practical improvement upon the present point switch with its tapering rails, although various improvements have been made in protecting and strengthening the points. The old and obsolete stub switch, with rails—of full section throughout—hinged at the end farthest from the crossing, had advantages in giving a continuous rail. But in its day it was of crude design and had serious disadvantages. Various modern developments of this type have been designed, but none have got beyond the drawing-office and patent department. For the crossing, the swing rail type is used extensively where one track is used much more than the other, the former being given a practically continuous rail. On some railways, however, this type of crossing is not used in main running tracks. Substitutes for crossings, in which the rail of the siding is elevated above that of the running track, have been tried experimentally. A promising device is a swing-rail crossing, which has given good results in trials, and in which the swinging rail is operated automatically and simultaneously with the points. With the points set for either line, the swing rail gives a continuous bearing for wheels on that line, avoiding the objectionable open gap of the ordinary crossing. This is simply a development of railway interlocking apparatus.

Track Shifting Machine.

One of the latest of the numerous machines used on railways is a track shifting and track lifting device, which can be adapted also to other kinds of work in maintenance of way. With the common method of using side-tip wagons in building and widening embankments, dams, and filling low ground with waste from steel works, quarries or open-cut mines, the construction track has to be continually shifted along the advancing edge of the bank, and it is ordinarily done by groups of men with lining bars or crowbars. A self-propelled petrol car grips the rails and then forces down a vertical post by means of a cog and rack, thus raising itself and the rails and sleepers. A lateral swing of the post then causes the track to slide laterally, the car then moving ahead and repeating the operation. For ballasting, a cross-frame takes the place of the post, so that the track is raised and kept level while ballast is placed and packed. In renewing rails, small cranes travelling on the track are in common use, and the machine noted can be adapted to that purpose by attaching a head frame and jib. In this form it can be used also to handle and stack material, such as rails, sleepers, piles or timbers. In one case the machine with its operator and four labourers laid rails as fast as a gang of twenty-eight labourers. In similar work in a goods yard the machine with its operator and three labourers did in half an hour as much work as fifty men in two hours. Railways, contractors, quarry and other companies are using the machine.

Remote-control Mine Haulage.

At the Palmer open-pit mine on the Michigan iron range a system of remote control operation of the railway wagons similar to that already installed at various quarries has been introduced. Tracks are laid in the pit to the several faces which are being worked by large electric excavators, and a double-track line leads up an incline to the crusher house, where the wagons tip the ore into a hopper which feeds the crushers. The four-wheel ore wagons are of the side-tipping type, and each has its motor and control apparatus, by which it is caused to operate at the will of a tower-man in an observation tower or cabin from which he has a view of the workings. Electric current is taken from a third rail laid between the running rails. No operators or brakemen are required on the wagons. By means of selective contactors on the wagons, the tower-man can start, stop and regulate the speed of each wagon independently. He can also operate the points, so that the wagons may be diverted and run upon any desired line. He sets an empty wagon on the loading track beside an excavator. At a signal that the

car is loaded, he causes it to move out on the running line and then run at 10 to 20 miles an hour to the incline and up into the crusher house. There it is tripped and tipped automatically and then passes round a loop to the return track. Enginemen and train crews are dispensed with, and two excavators now give the same output as three when served with trains of wagons.

A New Port.

One feature of the great industrial development of the south-west portion of the United States is the opening of a new deep-water port at Corpus Christi, Texas. The city is not situated directly on the Gulf coast, but on the land-locked Corpus Christi Bay, which is entered by the Aransas Pass Channel, 21 miles from the city. The main part of the port works is a basin, 1000ft. long and 300ft. wide, dredged in the low ground north of the city, the dredged material being deposited as a protective dyke or embankment and to fill a large area which will be utilised for railway goods yards, warehouses and factories. A 200ft. channel spanned by a bascule bridge connects the basin with the bay. Along one side of the basin is a quay of creosoted piles and timber with a concrete floor. Upon this, and set back 25ft. from the edge of the quay, is a transit shed, 170ft. wide and 1200ft. long, of steel frame construction, divided into four sections by transverse brick walls, 300ft. apart, as a fire protection. Beyond this is an open quay, 400ft. long, upon which an additional section of the transit shed will be built when required. Railway sidings and a concrete paved driveway extend along the rear of the shed. Provision is made for a ship repair yard. The basin has a minimum depth of 25ft. The port is under the management of a board of Commissioners.

Large High Conductivity Copper Castings.

COPPER of a high degree of chemical purity containing not less than 99·92 per cent. copper—the remainder consisting almost entirely of oxygen present in the form of cuprous oxide—has the property, when in the liquid state, of readily dissolving large volumes of certain gases, notably sulphur dioxide, which is almost inevitably present in the products of combustion of a refinery furnace. The solubility of the gas in the metal diminishes as the temperature of the liquid metal falls until the solidifying point is reached. The solubility in the liquid at that temperature is still appreciable. Sulphur dioxide, however, has only a negligible solubility in solid copper at that same temperature, and the liberation of gas which occurs during the solidification of the metal gives rise to numerous small bubbles, which may be trapped in the mass.

LARGE CASTINGS OF HIGH CONDUCTIVITY COPPER

Small castings of uniform cross section produced in chilled moulds do not present any great difficulty. They are, in fact, produced in vast quantities in the form of wire bars and cakes for subsequent rolling into wire and sheets. More complicated castings, or those presenting a large superficial area in relation to their weight, present a very much greater difficulty to the attainment of soundness. The use of deoxidisers to obtain soundness is not permissible for electrical work. A small trace of phosphorus, for example, has a very appreciable lowering effect on the conductivity.

During the last few years the question of the production of sound copper castings has received considerable attention both from the research workers of the British Non-ferrous Metals Research Association and also from companies engaged in the production of high-conductivity copper. Some idea of the degree of success which has been attained may be inferred from an inspection of the accompanying engraving, which shows some large copper rings of 100 per cent. conductivity which were cast by Thomas Bolton and Sons, Ltd., in the refinery at their Froghall Works. The engraving shows one ring after having been rough turned and another in the lathe in the process of turning. The dimensions of these rings as castings were approximately 7ft. external diameter and 4ft. 4in. internal diameter and 5in. thick, the rough weight being well over 2 tons.

JOINT MEETING OF INSTITUTIONS OF ENGINEERS AND SHIPBUILDERS.

THE Council of the Institution of Engineers and Shipbuilders in Scotland has decided to hold, in association with the North-East Coast Institution of Engineers and Shipbuilders, a summer meeting in Glasgow, from the 20th to the 23rd of June inclusive.

The following preliminary programme has been arranged. On Monday, June 20th, at 8 p.m., there will be a Conversazione at the Institution of Engineers and Shipbuilders in Scotland, following a Reception by the President, Mr. A. J. Campbell, and the members of Council.

On the Tuesday, at 10 a.m., an address of welcome will be delivered in the Rankine Hall by Lord Weir of Eastwood. The remainder of the morning will be devoted to the reading and discussion of the following papers:—"Historical References to the Progress in the Use of High-Pressure Steam," by Mr. James Mollison; and "The Trade Value of Simplification and Standardisation in the Details of Ships and their Machinery," by Mr. Charles le Maistre. In the afternoon, starting at 2.15, there will be alternative visits to the following works:—(*a*) G. and J. Weir, Ltd., Cathcart; (*b*) David Colville and Sons, Ltd., Cambuslang; (*c*) the Dalmarnock Electric Power Station of the Glasgow Corporation; and (*d*) the Fairfield Shipbuilding and Engineering Company, Ltd., Govan. In the evening, at 7.30 p.m., there will be a Reception in the City Chambers at the invitation of the Lord Provost, Mr. David Mason.

On the Wednesday morning, at 10 a.m., the meeting will be resumed in the Rankine Hall, when the following papers will be read and discussed:—(*a*) "Observations on Some Economic Factors in Modern Shipbuilding," by Mr. John McGovern; and "Motor Yachts and Motor Yachting on the Clyde," by Mr. F. L. MacLaren. In the afternoon there are to be alternative visits to the following works:—(*a*) Babcock and Wilcox, Ltd., Renfrew; (*b*) the Albion Motor Car Company, Ltd., Scotstoun; (*c*) Yarrow and Co., Ltd., Scotstoun; and (*d*) Mavor and Coulson, Ltd., Mile End, Glasgow. In the evening, at 8 p.m., there will be a dinner and dance at the Central Hotel, Gordon-street, Glasgow.

Thursday, June 23rd, has been set aside for an excursion on the Clyde in the new high-pressure turbine steamer King George V.

In addition to the visits to works already mentioned, visits to the following works may be made by arrangement:—On the Tuesday, Gilbert Austin, Ltd., Cathcart; Barclay, Curle and Co., Ltd., Scotstoun; Wm. Beardmore and Co., Ltd., Dalmuir; John Brown and Co., Ltd., Clydebank; and Wm. Denny and Brothers, Ltd., Dumbarton. On the Wednesday, Harland and Wolff, Ltd., Govan; James Howden and Co., Ltd., Glasgow; John Lang and Sons, Ltd., Johnstone; David Rowan and Co., Ltd., Glasgow; and Alexander Stephen and Sons, Ltd., Linthouse, Govan.

BOOKS OF REFERENCE.

"KELLY'S Directory of the Merchants, Manufacturers and Shippers of the World," published by Kelly's Directories, Ltd., 186, Strand, London, W.C. 2., in two volumes, price £3 4s. post free.—This year's issue is the forty-first edition of this most useful book of reference, and it is now so widely known that but little introduction is necessary. We may say, however, that Volume I. deals with foreign countries and their possessions, while Volume II. is devoted to Great Britain, India, and the British Dominions, Colonies, Protectorates and Dependencies. The portion of Volume II. which deals with Great Britain is divided into three sections covering respectively:—(*a*) England, Scotland and Wales; (*b*) London; and (*c*) Ireland, each of these sections being again divided into the following subsections:—(*a*) Alphabetical; (*b*) classified trades; (*c*) telegraphic addresses; (*d*) exporters; and (*e*) importers. The two volumes, which comprise more than one and a-half million names and deal with over twenty thousand places, form, as the publishers rightly claim, a gazetteer containing a fund of facts and figures likely to be of use to the business man. The work is indexed in four languages, and of the volumes of which it is the successor, we can say that we have frequently found information in them which was otherwise unobtainable.

LAUNCHES AND TRIAL TRIPS.

SWIFTWATER, steel screw steamer; built by Cowpen Dry Docks and Shipbuilding Company, Ltd., Blyth, to the order of Water Transports, Ltd., Montreal, Canada; dimensions, 258ft. by 42ft. 6in. by 20ft. 6in.; to carry 2300 tons deadweight. Engines, triple-expansion, 16in., 27in., 44in. by 33in. stroke; constructed by Blair and Co. (1926), Ltd., Stockton-on-Tees; a mean speed of 8¾ knots was obtained on trial trip, May 17th.

PECTEN, motor-driven oil tank vessel; built by Palmers Shipbuilding and Iron Company, Ltd., to the order of Anglo-Saxon Petroleum Company; to carry 10,000 tons deadweight. Engines, Werkspoor Diesel engines; constructed by North-Eastern Marine Engineering Company, Ltd.; carried out a successful trial trip, May 24th.

HAMILDOC, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steamships, Ltd., Canada. Engines, inverted marine type; constructed by MacColl and Pollock, Ltd., Sunderland; trial trip, May 25th.

ICOTEA, twin-screw oil tanker; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Company for the Lago Shipping Company; dimensions, 315ft. long by 50ft. Engines, triple-expansion; launch, May 26th.

LAGUNILLA, twin-screw oil tanker; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co., for the Lago Shipping Company; dimensions, 315ft. by 50ft. Engines, triple-expansion; launch, May 26th.

BRITISH INDUSTRY, oil tank steamer; built by Palmers Shipbuilding and Iron Company, Ltd., to the order of British Tanker Company, Ltd.; to carry 6300 tons deadweight. Engines, triple expansion; a speed of 11 knots was attained on trial trip, May 27th.

WELLANDOC, single-screw steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steamships, Ltd. Canada; dimensions, 253ft. long. Engines, inverted marine type; constructed by MacColl and Pollock, Ltd.; launch, May 28th.

TROUTPOOL, steamship; built by Wm. Gray and Co., Ltd.; to the order of Pool Shipping Company, Ltd. (Sir R. Ropner and Co., Ltd.); dimensions, 402ft. by 55ft. by 28ft. 9in. Engines, triple-expansion, 26in., 43in., 71in. by 48in. stroke, pressure 180 lb. per square inch; constructed by Central Marine Engine Works; trial trip, May 28th, 1927.

BOLIVAR, twin-screw oil tank steamer; built by Palmers' Shipbuilding and Iron Company, Ltd.; to the order of Venezuela Gulf Oil Company. Engines, twin-screw machinery; constructed by MacColl and Pollock; launch, May 30th, 1927.

CATALOGUES.

HIGGS MOTORS, Witton, Birmingham.—Latest list of industrial electric motors.

S. DAVIS AND CO., Aldwych House, Aldwych, W.C. 2.—A booklet entitled "Sales: How you can Stimulate Them."

RADIO COMMUNICATION COMPANY, Ltd., 34, Norfolk-street, W.C. 2.—Particulars of a ½-kilowatt marine radio set.

OERLIKON, Ltd., 28, Essex-street, London, W.C. 2.—Oerlikon Bulletins 66, 67 and 68, giving some particulars of the firm's activities.

THE MIDLAND ELECTRIC MANUFACTURING COMPANY, Ltd., Birmingham.—Sectional list No. 158, describing a new type of change-over switch.

S. RUSSELL AND SONS, Bath-lane, Leicester.—Leaflet illustrating Hill's flush side cold-sawing machine and Hill's automatic saw sharpener.

MARSHALL, SONS AND CO., Ltd., Britannia Ironworks, Gainsborough.—Publication No. 1708, dealing with "Cummer" asphalt plants and other road-making machinery.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Ltd., Falcon Works, Loughborough.—Publication 100/0–6A dealing with Brush-Ljungstrom turbo-generators from 5000 kilowatts normal rating to 7000 kilowatts continuous maximum rating.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, East Pittsburgh, Pa., U.S.A.—Leaflets on the following:—Dual frequency super-calender drive; loom motors and control; industrial electric furnaces; clip-type safety connectors.

HEAT ENGINE TRIALS COMMITTEE.—A meeting will be held at the Institution of Civil Engineers, on Friday, June 10th, at 6 p.m., when the report of the Special Committee on Tabulating the Results of Heat Engine Trials will be submitted for discussion. Mr. W. H. Patchell, M. Inst. C.E., chairman of the Committee, will take the chair. Members of the following Institutions and bodies, which have co-operated in the work of the Committee, are invited to attend this meeting:—The Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, the Institution of Electrical Engineers, the Institution of Engineers and Shipbuilders in Scotland, the North-East Coast Institution of Engineers and Shipbuilders, the Institute of Marine Engineers, the Institution of Gas Engineers, the Institution of Automobile Engineers, the Institute of Chemistry of Great Britain and Ireland, the Iron and Steel Institute, the Incorporated Municipal Electrical Association, the British Electrical and Allied Manufacturers' Association, the British Engineers' Association, the Diesel Engine Users' Association, and representatives of the Admiralty, the War Office, and the Air Ministry.

BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION.—The luncheon on the occasion of the seventh annual general meeting of the British Non-Ferrous Metals Research Association was held at the Savoy Hotel, London, on Friday, May 27th. A company numbering some 125 members and guests was presided over by Mr. Thomas Bolton, the chairman of the Association. In a speech after the luncheon, Mr. Bolton laid stress upon the advantages which were likely to accrue to users of non-ferrous metals if they would join the Association in greater numbers. He also remarked upon the desirability that young men should have scientific training. Sir Alfred Mond, who followed, emphasised the same point, insisting on the necessity for having men trained for the needs of the time, with scientific knowledge and a wide outlook. The present day salesman must, he said, have technical knowledge of the goods that he was sent out to sell, so that he could discuss the requirements of customers intelligently and supply them with exactly what they wanted. Sir Alfred also agreed that a combination between maker and user in research would make for the progress of industry and of the world. Sir Frank Heath, K.C.B., and Mr. H. T. Tizard, F.R.S, of the Department of Scientific and Industrial Research, also spoke.

Extinguishing Oil Fires Afloat.

IN view of the recently reported fire in the boiler-room of H.M.S. Renown, it seems appropriate, just now, to give the following particulars of a new apparatus specially designed to meet the requirements of the Board of Trade in connection with passenger-carrying vessels fired by oil. These regulations insist on the provision of apparatus capable of generating "foam" in sufficient quantities to cover the floors of engine and boiler spaces to a depth of 6in.

The illustrations accompanying this article show apparatus recently constructed for Scotts Shipbuilding Company, by Merryweather and Sons, of Greenwich, to meet the Board of Trade requirements for an oil-fired steamer, the floor area of whose stokehold is 700 square feet. This apparatus produces a foam to which the name of "Fire Suds" has been applied, and in it the makers claim to have produced a material that has ideal properties

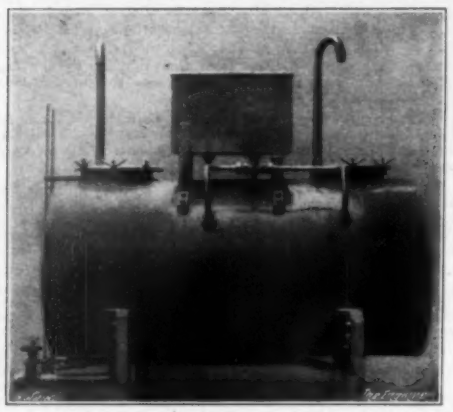


FIG. 1—MERRYWEATHER "FIRE SUDS" FOAM PRODUCER

for the purpose for which it is supplied. The principal ingredients consist of a solution of sodium bicarbonate with a froth producing substance, and a solution of aluminium sulphate.

The solutions, combined in the right proportions, produce a substance that, while containing large quantities of carbon dioxide embodied in its mass, is sufficiently liquid to flow quickly over the surface of burning oil and so prevent the access of oxygen. The two liquids forming Fire Suds on combination produce from eight to ten times their bulk of foam, and in the present instance the total quantity of liquid required is 250 gallons. This quantity of liquid ingredients is carried in a horizontal welded steel cylinder—as shown in Fig. 1—having two compartments, that containing the acid ingredient being lead lined. Each compartment has a large manhole with a cover secured by swing bolts. Over the cylinder is fixed a small rectangular open top tank for mixing the ingredients before they are allowed to enter the compartments of the cylinder.

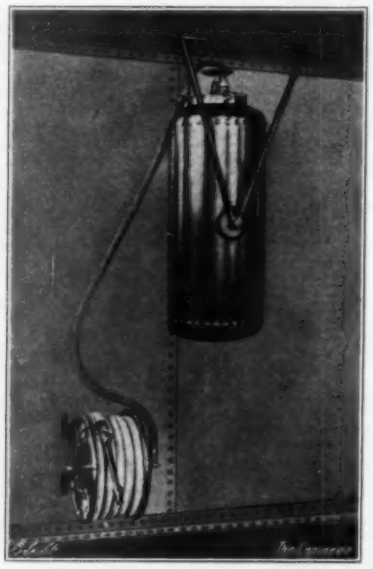


FIG. 2—BOILER ROOM "FIRE SUDS" PRODUCER

Ventilating pipes and gauges showing the height of the contents are fitted to each compartment.

The cylinder is fitted in the most convenient position on one of the upper decks, and the contents are distributed by gravity through two separate lines of piping of the correct diameter and taken to the most suitable positions relative to the area to be covered, where they combine as the point of efflux and form Fire Suds.

In addition to the apparatus described above, the Board of Trade require the provision of a separate appliance of smaller capacity for fixing in the boiler-room. This set is shown in Fig. 2, and consists of a steel cylinder having a capacity of 30 gallons containing the liquid ingredients in two separate compartments. The cylinder is supported on pivots screwed to a bulkhead and from the roof of the compartment. Upon inversion the two liquids mix instantly and form carbon dioxode under sufficient pressure to distribute the contents through a short line of flexible hose.

South African Engineering Notes.

Electric Power from City Reservoir.

Application has been made by the Electricity Supply Commission—appointed under Act of Parliament, 1922—for permission to make use of a certain quantity of surplus water discharged from the enlarged Steenbras Reservoir for the generation of power. The Steenbras Reservoir supplies the City of Cape Town, and when the raising of the dam wall and other necessary works are completed, its capacity will be increased to about 6000 million gallons of water. The Commission proposes to build, in the first instance, a small generating station just above sea level, below the Steenbras Tunnel exit, and there to install, say, three 600-kilowatt generating sets to be operated by the surplus water which it is understood will amount, in the initial stages, to some ten million gallons per day in summer and considerably more in winter during normal seasons—the volume of one flood exceeded 1000 million gallons in twenty-four hours. The Commission intends to construct a transmission line for the purpose of feeding into the Commission's rural supply system at Capex—some 20 miles or so from Cape Town. The Commission offers to defray any expenditure incurred, and to pay a royalty. Preliminary estimates indicate that the economic value to the Commission of the energy to be generated at the proposed station would be such that a royalty of something over £1000 per annum might be paid to the Corporation of Cape Town, that figure being based on 8,000,000 kilowatt-hours per annum, costing the Commission, at Capex, not more than 0·3d. per unit. The Board of Engineers of the Steenbras Extension Scheme has expressed the opinion that for approximately ten years to come a surplus, on an average, of 10,000,000 gallons per diem can be made available to the Commission for power purposes at the tunnel mouth, and it recommends that the proposals of the Commission be agreed to in principle, subject to certain provisos.

Wankie Colliery Reconstruction.

A big programme of plant reconstruction and expansion involving the expenditure of approximately £350,000 is now being carried on at the Wankie Colliery in Rhodesia. No other single coal-mining enterprise in Africa contains within its boundaries such a vast tonnage of coal as does this great colliery. Enormous and increasing quantities of coal and coke are forwarded daily to the great copper producing mine, the Union Minière du Haut Katango, in Belgian territory, and the supplies for the Broken Hill Mine will soon be on a scale only slightly smaller. As it is, there can be no question about it that, but for the Wankie Colliery, the Rhodesian Railways would have nothing approaching the present volume of well paying traffic, and the great copper industries in the North would be virtually impotent.

The *Mining and Industrial Magazine*, in a recent issue contained the following description of the plant reconstruction now proceeding. Forty new coke ovens of the retort pattern are being installed, replacing 25 beehive ovens, and the work of erection is about complete, and it is anticipated that the new retorts will be in commission very shortly. When they are finished the colliery will possess 180 retorts and 37 beehives, making a total of 217 coke ovens, which constitutes, by far and away, the largest plant of its kind in Africa. In addition to the increased coking plant, a new washery of 150 tons per hour capacity is being installed at the old (No. 1) colliery, and a very considerable portion of the plant is being reorganised. The new washery is being installed by the well-known Manchester firm of Simon Carves, Ltd. It was expected that it would be able to take up the work by the end of May or the beginning of June, in spite of difficulty in obtaining material in the early stages of construction. The first section of the new boilers is now under construction. New power plant which at present consists of two 750-kilowatt turbo-generator sets, is being installed at the old colliery. Two 3000-kilowatt sets are to be erected later—within the next three years.

The Wankie Company is at present opening up an entirely new colliery situated at a distance of about four miles to the north-west of the existing No. 1 pit. This new, or No. 2, colliery is being equipped with heapstead, screening, picking, conveying, elevating and breaking plant, and also with a British Baum washery, and will have an initial output capacity of 1000 tons per day, with provision for progress and expansion up to 5000 tons per diem. An incline with a dip of 1 in 8 has been carried down into the coal seam, which at the No. 2 colliery is 28ft. thick, the quality of the coal in this area of the company's concession being, if anything, superior to that which has made Wankie famous for the fuel won from its old No. 1 mine. Underground work is far enough advanced to provide an output of 500 tons per day as soon as the haulage, now on the ground, is installed. This output can be rapidly increased as soon as screening facilities are available.

State-aided Steel Industry.

The Executive Committee of the Association of Chambers of Commerce of South Africa in a detailed examination of the Iron and Steel Bill, just passed by Parliament, reiterates its oft-expressed objection to Government participation in trade, feeling that, from an economic point of view, such trading is highly detrimental to the best interests of South Africa. It recognises the importance of establishing an iron and steel industry, but holds that encouragement by the Government can be given by other means than those provided in the Bill. Claims, alleged to be exaggerated, put forward by the German experts, who recommended the establishment of the industry in South Africa, and who are responsible for the selection of Pretoria as the site, are alluded to. The German experts estimated a profit of £450,000 per annum, and it is pointed out that the cost of production at Pretoria was given at 70s. per ton, and the profit estimated at £10 10s. per ton. It is quite obvious that £14 per ton is an impossible price for raw iron when it is proposed to sell steel rails at £12 4s. and rod iron at £12 12s. Pig iron from the Newcastle Ironworks is being sold to-day at £5 12s. 6d. ex works, or £6 9s. per ton delivered in Johannesburg. It is clear, therefore, that, on this one item, the estimated profit of £73,500 on the production of 7000 tons of raw iron must be reduced by at least £60,000. Another important factor dealt with in the German experts' report is that of the cost of water. Consumption is estimated at 2,000,000 gallons per day, and the price is put at 2d. per thousand gallons. The present price to the public at Pretoria is 2s. per thousand gallons. Pretoria is even now short of water, and the only manner in which such a low rate could be arrived at is by the expenditure of at least £1,000,000 on a new water scheme, which is omitted entirely from the production costs in the experts' report.

A very important point also entirely omitted from consideration by the German experts is that after the raw iron is produced and an expensive plant set up for its conversion into steel—a capacity of about 130,000 tons of steel per annum is what the Government talks about—it would be necessary for subsidiary plants, for the manufacture of the large number of varieties and classes in daily use, to be working at their full capacity continuously and simultaneously with the manufacture of raw iron, if the expectations of the Government are to be realised, and the whole scheme run as an economic and payable proposition. It is extremely doubtful whether the demands of the country for the output of these subsidiary plants would be sufficient to keep them working for more than a short period of the year. If this assumption is correct, the Corporation will never be able to pay its way, let alone a dividend.

There are many other minor points which are dealt with by the Executive Committee, such as the fact that the railways, owing to the reservation of the supply of steel in the area suggested to the products of the Pretoria works, would suffer a reduction in railway revenue of £500,000 per annum, which revenue has hitherto been earned in the carriage of imported supplies. Against this there would be the revenue from the conveyance to the Pretoria works of coal and other raw materials, and of manufactured goods to the various consuming centres of the Union. How steel can be carried by rail over 1000 miles from Pretoria, to such a consuming centre as Cape Town, to compete with deliveries from overseas at the port, unless the railway carry at uneconomical rates, it is difficult to see. Finally, without touching on many minor points, there is the fact that coke and coal for the production of steel will have to be brought to Pretoria, and, as far as is known, the only really suitable coal for making coke for blast-furnace and steel purposes is in Natal, and at the very spot where the Newcastle blast-furnace is situated, and where many thousands of tons of coke are made to supply not only the blast-furnace but the Vereeniging and other steel works and engineering foundries and shops, so that carriage will be a considerable item. Naturally in a sheltered industry, especially one under Government control such as the proposed one will be, the standard of wages would be higher than in other industries, and the inclination would be to raise wages generally.

Yet, in spite of the foregoing, and of the opposition which it met with from other directions, the Bill passed through all stages in the House of Assembly, the Government defeating all amendments, and the Union is committed to an experiment which many consider to be doomed to failure. The fact that after investigation by British, American and continental experts, none of the interests they represented were prepared to put money into an iron and steel-making industry is enough by itself to condemn the enterprise. Sir Wm. Hoy, General Manager of Railways, in giving evidence only a short time back before the Commission appointed to report upon the feasibility of such a scheme, declared that South Africa could not absorb more than 50,000 tons of her own production of iron, that on such a small output it could not possibly pay, and that no external market could be hoped for, as, through mass production, other countries could supply other parts, even of South Africa, much cheaper than a Union industry could. Other witnesses were equally emphatic, but the Government has persisted. It is widely feared, however—in fact, it is almost regarded by many as a foregone conclusion—that it will mean the ruin of the private industry already established after years of struggling. The reason for this belief is that the Government in the Act binds the Railway Administration to take all its requirements for the next ten years from the new company which is to be formed. That will mean that the Union Steel Corporation (S.A.), Ltd., will lose more than half of the work which it executes at present.

Railway Repair Shops.

Rapid progress is being made with the construction of the railway repair workshops, which are situated between Germiston and Keswick, not far from Johannesburg. Parliament placed a sum of £260,000 on the estimates last year, and nearly £30,000 has been expended, and the first section is being opened at once. A number of men have been transferred from other railway centres, and more will be sent as the sections are completed. The main building erected is 300ft. in length, a large boiler-house is nearing completion, and in the blacksmith's shop, forges and a big steam hammer are in readiness. All other shops are also equipped and ready for use. Many new sidings have been constructed, and several trains of disabled trucks and coaches have been drawn into the yards ready to be dealt with.

Electrification Results.

The engine-drivers on the electrified portion of the Natal main line have approached the Administration with a request for increased remuneration. They state that their earning power has been decreased since electrification, that they have increased responsibility and increased mileage. The returns show that the decreased time on each trip as compared with steam has reduced their earning powers by 33⅓ per cent. in the case of the Pietermaritzburg section and 55 per cent. on the Daimana–Mooi River section. The load from Glencoe to Daimana has increased from 720 to 1495 tons, and Mooi River to Pietermaritzburg from 755 to 1495 tons. This also refers to the up journey. The speed has been increased from 8 miles per hour to 21, and down the banks the speed has increased to 25 miles per hour. The increased mileage is very considerable. With the run to Glencoe two trips are worked now instead of one under steam.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Paltry Demand.

THAT there is something radically wrong with demand would appear to be conclusively proved by the fact that the recent substantial reductions in iron and steel prices have failed to stimulate demand. During the past fortnight the amount of business transacted on the Birmingham Exchange has been meagre indeed, and this despite the fact that before the fall in prices inquiries were so numerous that producers felt it only needed a slight giving way on their part to ensure quite a large volume of business. Many of the large manufacturing works in the Midlands and Staffordshire are none too well placed as far as work is concerned, and they have little actual need to buy forward. Moreover, there seems to be a fairly general consensus of opinion that the depreciation of raw material prices has some way to go yet before it will pay works to buy forward. Smelters in this area have this week offered further concessions without appreciably adding to their order books, while re-rollers to-day intimated that the reduction of 10s. per ton in small bars failed to increase orders either in numbers or tonnage. Consumers must bear in mind that production costs are still relatively high, and that there are limits to the ground which producers can yield and yet produce at a profit. That this point has almost, if not quite, been reached is evidenced by the fact that there is increased talk of damping down furnaces, and by the news that in other districts this has already become an accomplished fact. A return to the idle conditions of last year by the furnaces would be a matter for much regret, and it is sincerely to be hoped that consumers of iron and steel will see the necessity and advisability of buying immediately at least as much material as is warranted by the state of their order books and their rate of output.

Pig Iron Values.

The further cut in pig iron prices by Cleveland smelters has to a smaller extent been followed this week by Midland producers. Many of those who refused to place contracts for coke at the opening of the quarter when the price stood at 22s. per ton are now reaping some benefit from the fall in fuel values, and they are prepared to pass this on to the consumer of pig iron if only he will place more or larger orders to enable the furnaces to be kept going. There are other Midland smelters, however, who entered into contracts for coke, and who naturally, with the higher production costs, are disinclined further to reduce raw iron prices. They have little option, however, in the matter, for obviously with offers of supplies of Derbyshire No. 3 foundry at £3 12s. 6d. consumers will not pay more and makers must either accept that price or see the business go elsewhere. The unfortunate part of the whole affair is that demand appears to have been stimulated hardly at all by the reduction in prices. Buying on 'Change in Birmingham to-day—Thursday—was on the most meagre scale, and forward business was no more contemplated than was the case a month ago when values were about 7s. 6d. per ton higher than to-day. The hand-to-mouth manner of buying indeed has become an established method. Consumers claim that they stand to lose so little, but that in their opinion values will decrease so substantially during the next few months that they have much to gain by abstention from forward contracting. Demand is so sluggish that the position has become extremely serious from the producers' point of view, and there is considerable talk of following the course adopted in other parts of the kingdom and damping down furnaces until such time as a demand which will absorb their full output of forge and foundry grade irons makes itself evident. At the moment there is not sufficient business to steady the price of Derbyshire No. 3 at the new figure of £3 12s. 6d., and Northamptonshire foundry at £3 10s. is decidedly weak and £3 7s. 6d. would probably be accepted. Forge qualities are so little called for that it is difficult to give even an approximate selling value. It may be producers would be prepared to accept orders at a discount commensurate with the depreciation in foundry numbers. Smelters now experience no difficulty in obtaining ample supplies of coke at from 16s. per ton upwards. For good reliable grades they are willing to pay 17s., or about 2s. 6d. per ton above the pre-strike figure. Midland foundries are not so well off for orders as they have been, and are not taking more iron than they need at the moment. It would appear, however, that foundrymen are not buying pig iron on a scale proportionate to their output, even when full allowance is made for the falling off in the demand for castings. It is thought in some quarters, and there are evidences which tend to confirm it, that foundrymen are making increasing use of scrap in place of pig iron for castings as well as some rolled products. The exigencies of last year taught them the use to which scrap could be put in this direction, and it is thought that they are now utilising it in an endeavour to lower pig iron values. Stocks of pig iron at furnaces are accumulating, and unless there is a decided improvement in demand shortly a curtailment of production must be expected.

Steel.

Only a comparatively small release of business has resulted from the return of the angle and joist mills to the £7 12s. 6d. basis for contracts. No one seems anxious to place contracts now that supplies are freer. While some mills have good reserves, others are only carrying on with such meagre orders as come to hand. The plate mills are said to be badly in need of new business. Ship, bridge and tank plates remain at £8 7s. 6d. Staffordshire hoops make £10 10s. at works. Boiler plates are a trifle weaker, more sellers being prepared to accept the £11 figure. Small steel bars, rolled from continental billets, have declined in value by some 10s. per ton. On 'Change to-day they were procurable at £8 though the general quotation was a little above this level. Mild steel billets sell but slowly at £6 15s. to £7. Few new steel orders of any size are being given out either to home or foreign firms.

Finished Iron.

In the Staffordshire finished iron trade demand shows little improvement. Makers of best iron are able to carry on with such slender orders as come to hand, but they have practically no reserves. There is a fairly steady call for special irons in connection with chain and cable making, but the effect of improved shipbuilding takes some time to filter through to local works. This applies also to the nut and bolt trade, which is still rather dull, and shows no improvement since the beginning of the year. Prices are unchanged at £14 10s. for marked bars, unmarked Crown quality £10 15s., and nut and bolt quality at £10 5s. The bulk of iron used in the nut and bolt works is imported from Belgium, because the rates are substantially lower, Belgian No. 3 iron being obtainable at about £6 2s. 6d. delivered into the district.

Sheet Values Easier.

Makers of galvanised sheets have been unable to maintain the £14 15s. minimum. Some mills not so well situated have this week quoted 24 gauge corrugated sheets at a reduction of half-a-crown per ton, viz., £14 12s. 6d. There were on 'Change to-day, however, producers who refused to consider business on these terms. For the most part, they were those who a week ago asked £15 for their output. Business is reported to be fairly good, but competition for it is keen.

Continental Competition.

Continental competition continues as keen as ever in this district, notwithstanding the fact that, whereas the tendency of prices of British-made material is towards lower levels, some classes of imported iron and steel—from Belgium and France chiefly—are dearer. Continental billets, for instance, are quite 2s. dearer than a week ago. The disparity between British and foreign quotations remains so wide, however, that manufacturers in this area are making use of the cheaper material to an increased extent. Considerable quantities are being received weekly into the Black Country, much to the chagrin of Staffordshire producers, whose production costs prohibit them from effective competition.

Gas Engineers Visit Dudley.

Members of the Midland Association of Gas Engineers and Managers had an interesting day last week when they visited Dudley. Prior to the business meeting, they surveyed the Netherton Ironworks, forges and mills of W. Hingley and Sons, Ltd., where they saw the operation of making best Staffordshire wrought iron from puddling furnace to finishing mill, and also the making and testing of large ship's cables. They inspected the Dudley gasworks, and had an opportunity of seeing one of the newer industries of the town by visiting the works of Metallisation, Ltd., where they saw the "Schoop" process of metal spraying.

A New Science.

Professor D. Henson, of the Birmingham University, in an address on Monday on "The Development of Metallurgical Science," said we were now beginning, as a result of research, to acquire a scientific foundation for the treatment of metals so that their character might be altered. A new science had, in fact, been developed, and the old art of metallurgy was now under the control of highly educated scientific men. This new science was going to affect very considerably many industrial operations, and was going to place many methods of manufacture upon a sound scientific basis. The application of metallurgical science to industry was proceeding to a considerable extent in some trades, and it was extending continuously.

Courtauld's Second Wolverhampton Factory.

A start was made on Monday on the erection of Messrs. Courtauld's second factory at Wolverhampton. The first factory, it is expected, will be running by the end of the present summer; the second factory will not be completed until the end of next year, by which time, it is anticipated, 6000 hands will be employed. The cost of the first of the two factories was 1½ millions and the second is, I understand, to be an exact replica of the first. At present the firm employs 2200 hands at the Wolverhampton works, of whom just over half are girls. Another 800 hands, half of them girls, are to be taken on between now and August.

Obituary.

The death has occurred of a well-known member of the Birmingham Exchange in the person of Mr. Enoch Wilkes, of Newick, Streetly, Sutton Coldfield, chairman of Wilkes, Ltd., nut and bolt manufacturers, of the Grand Junction Works, Darlaston. Mr. Wilkes, who was aged sixty, took over the old-established firm of Messrs. Simpson in 1890, and, with the assistance of his uncle, Mr. Thomas Wilkes, had built up a flourishing business. It was converted into a limited liability company in 1897. Mr. Wilkes was a native of Darlaston, his father and grandfather having been in the nut and bolt business at the Britannia Works, established in 1832.

Unemployment.

Of the 8265 additional workers who were thrown out of employment in the Midlands a week ago, only 389 have as yet been reabsorbed. That there has been no further increase, but a slight trend in the right direction, is something. The total of unemployed in the Midland area is now 139,436. So far as the Birmingham area is concerned, there has been a falling off of 780 in the number of persons unemployed, bringing the total to 21,894.

Stainless Steel Castings.

I understand that Gabriel and Co., of 4 and 5, A. B. Row, Birmingham, have recently installed a special plant for the production of stainless steel castings. The material employed is known as Staybrite, which is one of the latest forms of stainless steel made by Thos. Firth and Sons, Ltd., of Sheffield. Messrs. Gabriel are, I gather, specialising in small castings of from 1 oz. to 30 lb., to take the place of articles which have hitherto been produced by stamping. This is a new departure for Birmingham.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The Electrical Age.

THE effect of the development of electricity upon the firm's business has been the subject of a letter to shareholders by Sir William Thom, managing director of Yates and Thom, Ltd., engineers and boilermakers, of the Canal Engineering Works, Blackburn, in connection with the calling of an extraordinary meeting for Tuesday of this week, at which a resolution was passed to the effect that the company be wound up voluntarily. In the course of his letter, Sir William points out that competition in the firm's branch of the engineering industry is keener now than it has ever been, and that the steady advance in the use of electricity and the numerous large power stations erected in various parts of the country are making great inroads into the firm's business. "For some time," he says, "we had found it impossible to keep our men and our machines working at anything like a reasonable production. Every endeavour has been made to find new manufactures to increase our output, but without success. A turnover to a new branch of engineering would entail a large capital expenditure, coupled with considerable risk and doubtful results." Whilst the company is financially sound, the general trading is at present being carried on at such a loss that a few more years under similar conditions would result in a loss to the shareholders which to-day can be avoided. Sir William states that the company has sufficient assets to ensure payment in full of its outstanding debenture stock and its creditors, and, in addition, 20s. in the pound to the preference shareholders, with the probability of a similar eventual payment to the ordinary shareholders. It should be pointed out that the firm was originally established over a hundred years ago, and that its development has run largely on parallel lines with that of Lancashire's staple industries.

Manchester and Salford Progress.

Interesting information bearing on electrical developments in Manchester and Salford is furnished in the annual reports for the past year of the Electricity Departments of the two cities. In the case of Manchester, in addition to extensions at a number of sub-stations, new sub-stations have been constructed at Blackley, Burnage, Clayton, Nuthurst, and West Droylsden. More than 55 miles of mains were added, making a total of 819. The increase in the volume of business has been 7·7 per cent., and the surplus of revenue over expenditure £40,659, compared with £32,857 in 1925–6. The price of coal rose during last year's dispute by 152d. per ton, but the weight of fuel consumed per kilowatt-hour of electricity sold fell from 2·09 lb. to 2·02 lb. The net profit of the Salford Electricity Department for the year ended March 31st, was £12,148, notwithstanding the fact that the undertaking had to pay an additional £30,000 for fuel as a result of the coal stoppage. The department last year turned into the mains 58,463,223 units, representing a coal consumption of 53,728 tons. In the preceding twelve months only 54,753,991 units were sent into the mains with a coal consumption of 56,717 tons, showing a saving last year of about 3000 tons of coal and an increase in electricity of 3¾ million units.

Equipment for Malaya.

In connection with important power development schemes in the Malay Peninsula, a large contract for high-voltage electrical equipment has been placed with the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester. An official announcement of the company states that the contract covers the supply of all the outdoor switchgear, with a large amount of indoor gear for two power stations. The main items comprise over 100 circuit breakers, weighing up to 10 tons each, and nearly 700 high-voltage isolating switches, with the steel work for the frame structures. The Metropolitan-Vickers Company has recently completed a big contract for switchgear for the Witbank scheme of the Victoria Falls Power Company, and with this exception, it is stated that the order for Malaya is probably the largest for outdoor switchgear ever placed with British manufacturers.

Non-ferrous Metals.

The market for non-ferrous metals is still decidedly bearish in tone, in spite of the fact that in the case of copper the values at the moment are slightly better than they were a week ago. The improvement in the latter, however, has been confined to the early days of the present week, following a period in which prices steadily moved lower. There has been a certain amount of buying by British cable makers, but, on the whole, the demand here is not sufficient to provide any adequate support to the market. In America also users have latterly been very sparing in their commitments. At the lower prices ruling during the closing days of last week an improvement in the demand for forward delivery—largely speculative—helped the market for standard metal, and the loss up to then has since been fully recovered, values on balance being rather higher than they were a week ago. Conditions in the case of tin since my last report have, however, been almost exactly the reverse of those outlined above for copper. Stocks of the metal in this country are relatively low, and this factor, coupled with a certain amount of liveliness in the demand, resulted in a continuation of the advance referred to in my last report. Since then, however, prices have fallen sharply and pretty well the whole

of the improvement registered in the previous week has been wiped out. With supplies of lead greatly exceeding the present demand for this metal, and with particularly heavy offerings from the United States, lead has lost a further 5s., and this section of the market shows no indication of recovery yet from its long-continued weakness. Spelter has also lost ground, and here again the decline is largely attributable to heavy selling pressure.

Iron.

Unsatisfactory as has been the condition of the pig iron market for some time, from the point of view of actual business done, things have been even quieter this week, if anything, owing to the overshadowing influence of the approaching holidays. The trading community in Manchester and in many Lancashire towns outside Manchester, religiously grumble every year at the dislocation to business which the Whitsuntide holidays cause in this part of the country, but they observe them just as religiously each year. Next week's sessions on 'Change only extend over one whole day and two half days, and this about represents the extent of the average working week in Manchester during Whitsuntide. The result has been that little interest has been shown by users, more particularly in view of the fact that the opinion is held that prices have not yet come down to their fullest extent. Virtually all the buying that has been going on during the past week has been for early delivery, and there is very little contract buying. Quotations continue to decline almost daily, and the full effect of the recent substantial reduction by Middlesbrough makers has probably not yet been seen. About the highest price one hears of in connection with Derbyshire brands is 81s. per ton, delivered into this district, with Staffordshire nominally a shade dearer, although in each instance makers are not disposed to turn away business for the sake of another shilling. Cheaper fuel, if it has not so far made much difference to current production costs, has certainly made the outlook for the pig iron industry rather brighter. Middlesbrough No. 3 is unchanged for delivery to Manchester or equal distance at 83s. 2d. Scottish brands, however, are easier at 98s., whilst hematites are quoted at 93s., both delivered. Bar iron is still quiet, but prices are maintained at £11 per ton for Lancashire Crown bars and £10 per ton for seconds.

Steel.

In the steel market buyers are still reluctant to place any important weight of business in the hope that before long the Association quotations for ship plates and sections will have undergone revision. The result is that orders are of small extent, and forward inquiry is noticeably scarce. Boiler plates are on offer here at £11 5s. per ton, with ship and tank plates at £8 7s. 6d., joists and sections at £7 12s. 6d., basic bars at £8 15s., and small rerolled bars at £8 2s. 6d. Sellers of continental steels—both finished and semi-finished—are also meeting with very unresponsive buyers, and although there is, of course, a fairly constant stream of business, it does not amount to much in the aggregate. In spite of these conditions, however, the prices that are being quoted here are moving upwards, Siemens plates now being at £7 7s. 6d. per ton, ordinary plates at £7 2s. 6d., joists at £5 17s. 6d. to £6, steel bars at about £6, sheet bars at £5 12s. 6d., and billets at £5 7s. 6d., for net cash against documents and including delivery to buyers' works in the Lancashire area. The demand for galvanised sheets has fallen off again, but prices are unaltered at £14 12s. 6d. per ton f.o.b.

BARROW-IN-FURNESS.

Hematite.

The fact that makers have reduced the price of hematite pig iron a matter of a couple of shillings may be the means of bringing into the market more buyers who are inclined to place orders for forward delivery. The producers at present are secure as regards orders, but the deliveries have been heavier than the orders, and thus the time when production might have to be reduced was approaching more rapidly than the district desired. Now there may be a change for the better as regards orders, for it is generally admitted that the requirements of customers in the various districts are likely to be substantial for some time. The fact that coke has fallen in price has been the cause of iron falling in sympathy. In a very short time it is hoped that prices generally will become normal, and then will be the time to review the possibilities of the iron trade in the district. There is a fair amount of optimism at present. Stocks are practically non-existent and practically all the iron made is booked. The steel departments continue to take a substantial tonnage every week. There is not a great amount of life in the steel market at present, but the mills are kept engaged, and are likely to be for some time yet. There have been shipments abroad recently. The iron ore trade is steady, and the demand is better this year than it was for several years before the dispute.

Electricity.

The Barrow Corporation has obtained powers to extend its power station and has also received permission to borrow the money. This extension is overdue, for the demand is rapidly increasing in the area. At present there is sometimes an overload, and it has been necessary to obtain power from the power station at Vickers Ltd.

SHEFFIELD.

(From our own Correspondent.)

The Demand for Steel.

THE exceptional activity which has characterised the big steelmaking departments of this district since the termination of the coal dispute is not fully maintained. Work is still in progress on a large scale, but it is only with much difficulty that the great open-hearth furnaces are kept operating. Since Easter, six or seven of them have been put out of commission, and, as there is a continued dearth of forward orders, further curtailments of production are likely. The outlook for the future is, however, better than this would indicate, as there is now a likelihood of those cheaper prices for which consumers of steel have been waiting. Pig iron has been too dear owing to the high charges for coke, but the latter material has now fallen substantially. It is still about half-a-crown a ton more than before the coal stoppage, but 5s. less than it was six weeks ago. The blast-furnace owners are pressing for further reductions. There have already been some concessions in the price of pig iron, but they have not yet been followed by modifications in the charges for steel, and the fact that orders for that material are still being placed very sparingly indicates that users are holding back in the expectation of early reductions. It is generally considered that the falls in pig iron and coke bring the trade revival appreciably nearer, but buyers will naturally wait until the market appears to have touched bottom. Few of them have anything substantial in stock or bought on contract. At the rolling mills and forges there is still only moderate employment, but conditions do not appear to be getting worse. Orders are numerous but individually small, and many of them scarcely yield a profit.

Orders on Hand and in View.

The *Journal* of the Sheffield Chamber of Commerce takes a very hopeful view of the future of the city's trades. It considers that Sheffield firms will probably get a lot of the business involved in the latest New Zealand loan of £6,000,000, most of which money will be spent on railway construction, hydro-electrical works, telegraphs and other public works calling for high-class steel goods. The *Journal* also states that "a firm with its biggest plant in Sheffield is on the point of booking a £3,000,000 ordnance order on account of the Republic of Bolivia, with prospects of more to follow." An order actually booked, which will be of benefit to Sheffield, is one received by John Brown and Co., Ltd., for two large North Atlantic liners, each of 18,000 tons gross, with accommodation for 1600 passengers, for the Canadian Pacific Railway Company. The bulk of the work will be done at Clydebank, but it is understood that various forgings required for the machinery of the vessels will be made in Sheffield. The city is also interested to learn that the Metropolitan-Vickers Electrical Company, of Manchester and Sheffield, have just booked what is, with one exception, the largest contract for outdoor switchgear ever placed with a British firm. It is in connection with the power development scheme being carried out in the Malay Peninsula by the Perak River Hydro-Electric Company to provide a supply of electricity for the Kinta Valley tin mining district. The order covers the supply of all outdoor switch gear, together with a considerable amount of indoor gear. The main items of apparatus comprise more than a hundred massive circuit breakers, weighing 10 tons each, for handling large amounts of power at high voltages, nearly 700 high-voltage isolating switches and the necessary steelwork for such installations.

Sheffield Steel for St. Paul's.

In a paper read before the Institution of Aeronautical Engineers last week, Mr. S. A. Main, of the Hadfield Research Laboratories, Sheffield, mentioned the interesting fact that a special new type of non-corrodible steel, made by Hadfields, Ltd., had been used for reinforcements in the restoration of St. Paul's Cathedral. He said that the material was required in the form of tie bars 3in. and 4in. in diameter, with their couplers and wall plates, and amounted to a total weight of 20 tons. The reinforcements were to replace those originally used by Sir Christopher Wren, which were made from wrought iron.

Colliery Progress.

The valuable Barnsley seam of coal is believed to be almost within sight at the new colliery which is being sunk at Upton, near South Elmsall, in the Wakefield district. The East Pit has now been sunk to a depth of 670 yards, and it is expected that the Barnsley bed will be struck, at about 700 yards, within the next two or three weeks. At the West Pit sinking has been hindered by water difficulties, but these have now been overcome by the installation of permanent pumping apparatus, and the depth is approaching 600 yards. The new colliery is a joint enterprise of the Cortonwood Colliery Company and Bolckow, Vaughan and Co., Ltd. The area of coal runs to about 8000 acres, and it is expected that when developments are completed the colliery will employ 4000 men and will have a weekly output of 30,000 tons. It was announced a few weeks ago that the Treasury had guaranteed under the Trades Facilities Acts a sum of £250,000 to the Sheffield Coal Company, Ltd., for colliery development at Aston. Some further details were made public before the Railway and Canal Commission last week, when sanction was given for a meeting of the shareholders of the Sheffield Coal Company to be held to approve a scheme for the amalgamation of that company and the Aston Colliery Company and the absorption of Beeton Ovens, Ltd. It was stated that the Treasury had consented to guarantee repayment of principal and interest on a loan debenture issue of £250,000 to be made by the Sheffield Company. The national advantages of the scheme would be colliery development by the sinking of a new shaft of greater dimensions than the Aston Colliery, and the working of an increased area of coal.

The Lighter Trades.

The light castings trade is but poorly employed, the foundries having been very quiet all this year. In cutlery and plate conditions are rather improved, chiefly on overseas account. Fairly substantial orders have recently been booked for knives, forks and spoons for the Colonies. In most cases, however, these markets require only the cheapest goods, and in connection with some large inquiries recently made, the price stipulations were such that firms with a reputation for high quality were unable to consider them. There is still a sale for cutlery and plate of good class, but the quantities are small as compared with cheap lines. The ordinary retail trade in this country is very poor. The well-known firm of Joseph Rodgers and Sons, Ltd., have just booked an order for 35,000 clasp knives for the War Office.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron Trade Slump.

ANTICIPATIONS in the Cleveland pig iron trade have been completely confounded. The price reductions have brought in very few orders, and there are openly expressed fears that more and more furnaces will have to go out of action. Following upon the damping down of three blast-furnaces on hematite iron at the Ayresome Ironworks, Middlesbrough, last week-end, comes the news of the posting of notices at Pease and Partners' Teesbridge Ironworks, Stockton, intimating that two blast-furnaces are to be damped down at the end of this week. This will directly affect 250 men, and will reduce the number of furnaces in operation on the North-East Coast to 42, as compared with 38 which were in blast prior to the general strike. Pease and Partners have been obliged to take this step because lack of demand for Cleveland iron has resulted in over-production and the consequent accumulation of big stocks. Smith's Dock Company, Ltd., is threatened with the necessity of closing down its Tees shipyard at South Bank in the near future owing to the lack of work. Only one ship remains on the ways, and when that is launched the firm has nothing on order to occupy a single berth.

Cleveland Iron Market.

An atmosphere of profound gloom prevails on the Cleveland iron market. There has been a most disappointing response to the latest price cuts. Works which are using Cleveland iron continue only to buy from hand to mouth, and both Scottish and continental markets are almost completely cut off by severe foreign competition. Hence there seems no other alternative to the further restriction of output. It is understood that Scottish buyers have big contracts for continental iron for June and July delivery, and these will have to be completed before there is much chance for Cleveland iron even at a competitive figure. Some buyers seem to expect further price cuts, but as makers are already selling below cost, it is doubtful, to say the least, whether any further reductions can be made. Current quotations are :—No. 1 Cleveland foundry iron, 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d.

Hematite Pig Iron.

The steady decline in hematite values seems to have been arrested by the stoppage of the three blast-furnaces at the Ayresome Ironworks, and the tone of the market is just a little better. There have been a few sales abroad, and makers are showing a readiness to meet purchasers when definite business is offered. Mixed numbers are steady at 79s., and No. 1 quality at 79s. 6d. per ton.

Ironmaking Materials.

With blast-furnaces stopping there is no demand for foreign ore. Imports under running contracts continue on a heavy scale, and consumers are reported to have heavy stocks. Best Rubio ore is steady at 22s. per ton c.i.f. Tees. The ironmasters continue to hope for cheaper fuel, but 22s. per ton is still generally quoted as the delivered price of good Durham furnace coke, though possibly better terms might be arranged for a three months' contract. There is, however, talk of ovens being put out of action.

Manufactured Iron and Steel.

The situation in the manufactured iron and steel trade is less promising. Contracts are being rapidly worked off, and new orders are not coming along in sufficient volume to ensure the same high standard of production as has been achieved during the past few months. Steel prices are stabilised until September, and the only change this week is a 10s. drop in the price of iron bars, common iron bars now being £11 5s.; best bars, £11 15s.; and best best bars, £12 5s.

The Coal Trade.

The Northern coal trade shows no signs of improvement, and the outlook is very discouraging. With the exception of a fairly well maintained demand for best large steams, the Northumberland and Durham markets have undergone very little change during the week. Export trade in all branches is very poor and inquiry slow. When offers are submitted abroad they are frequently met by counter offers at lower prices. There are evidently heavy stocks of coal on the Continent, and the competition consequently is increasingly keen for any business that may come along. The new French decree regarding import licences for coal and coke may ultimately affect this area, as it is evidently intended to stimulate the use industrially of French coal, of which there are considerable stocks in France. The lack of demand, both for home consumption and shipment, is seriously affecting the collieries in Northumberland and Durham. Another large colliery company in Northumberland—Backworth—is about to run its pits on the single shaft system. This will result in a large number of men being dispensed with. There are four collieries in this group, and the policy of the company is based on the urgent need for more economical working in the existing trade conditions. A better tone is reported for Durham coking unscreened coals, and while ample supplies are still obtainable for June shipment, prices are quoted steadier at 14s. to 15s. Steam coals continue in fair request, and the Swedish State Railways are in the market for 187,000 tons for shipment from June to November. The steam small coal position is irregular, but slightly better in tone. Best qualities are offered at

9s. 9d. to 10s. 3d., and secondaries at 9s. 6d. Durham gas coals show no special movement, and values remain about stationary. The coke trade is quiet, but fairly steady, prices being unchanged.

Coal Miners' Wages.

Ever since the pits resumed work after the national stoppage the monthly official ascertainments by which the men's wages are fixed have shown the economic position to be worse and worse, and the latest figures are striking, indicating how badly the industry is being hit by bad trade and low prices. The joint report of the accountants for Northumberland shows that the percentage on base rates is 35·95, or a decrease of 18·51 on the previous month, but as the minimum under the county agreement is 80, wages will remain unchanged during June. Thus the deficiency which has to be made up by the owners is 44·05 per cent., a burden which no industry can bear for long. The return of the Durham percentage is not so bad as in Northumberland. The report shows that the percentage on basis rates would be 49·99 per cent., compared with 64·82 per cent. in March, a decrease of 14·83 per cent. The minimum percentage under the county agreement, however, is 89, and therefore wages this month will be unaltered.

Iron Trade Wages.

Owing to a fall in the average realised selling prices of bars and angles during the two months ending April last, there will be a reduction of 2½ per cent. in puddling and other forge and mill wages in the North of England manufactured iron trade as from Monday last.

SCOTLAND.

(From our own Correspondent.)

Clyde Shipbuilding.

THE output during the month of May is fairly satisfactory, though perhaps smaller than might have been expected, considering the amount of work on hand. Work has been retarded, however, by irregular deliveries of essential materials, and an improvement in that respect would soon be reflected in the monthly returns. During May twenty-four vessels of 26,775 tons aggregate were launched from Clyde yards, and chief amongst them were the following:—Canberra, light cruiser, 10,000 tons, built by John Brown and Co., Clydebank, for the Australian Government; Dalveen, cargo, 5190 tons, built by Messrs. Scotts, Greenock, for the United Steam Navigation Company, Ltd., London. Contracts announced during the month of May included the following:—John Brown and Co. to build two geared turbine liners, each of 18,000 tons, for the Canadian Pacific Railway Company, and two motor ships of 530ft. in length for the New Zealand Shipping Company, Ltd., London; D. and W. Henderson, Glasgow, a cargo steamer of 8300 tons, for Maclay and MacIntyre, Glasgow; Connell and Co., Glasgow, a cargo steamer of 9200 tons, for Leith owners; and numerous small craft.

Steel.

Many producers of steel have sufficient orders on hand to preserve employment for some time to come, but are, nevertheless, becoming somewhat anxious about the lack of fresh business. The rise in the price of continental ship plates may benefit local producers to some extent, but in the meantime orders are generally of a hand-to-mouth description. Consumers of heavy steel continue to press for deliveries against old contracts. The home price of ship plates at £8 2s. 6d. is now round about 10s. per ton higher than the continental quotation for delivery in the Clyde area.

Steel Sheets.

Some makers of black and galvanised sheets have recently experienced a good demand, but on the whole orders for most descriptions would be welcomed. The home price for galvanised sheets is in the vicinity of £15 5s. per ton, with export £15 per ton f.o.b. Glasgow. Black sheets, ¼in., are quoted £9 17s. 6d. per ton, home, and £9 12s. 6d. per ton export delivery. Makers are not disposed to sell far ahead at present, as there seems to be an indication of a rise in price of foreign raw materials.

Iron: Reduced Prices.

The iron market continues to show a state of depression. Orders for bar iron and re-rolled steel are few and far between and comparatively small, and the works are poorly engaged. Scottish malleable iron makers have decided to make a further reduction of 10s. per ton in basis prices, and Crown quality bar iron will now be quoted £10 15s. per ton delivered Glasgow. Re-rolled steel bars remain at £8 2s. 6d. per ton. home delivery and almost a similar level for export.

Pig Iron.

Inquiries for hematite and foundry pig iron are not expanding as anticipated, and despite the restricted outputs, supplies are mainly plentiful. The market shows continued weakness, prices being as follows:—Hematite, £4 4s.; No. 1 foundry, £4 7s. 6d.; and No. 3 foundry, £4 2s. 6d.—all per ton for home delivery.

Imports and Exports.

Imports of iron ore at Glasgow were lower than usual at 25,000 tons for the week. Pig iron imports amounted to 2500 tons and manufactured iron 1700 tons. Manufactured material to the extent of 5600 tons was exported, chiefly to Australia, India, South Africa and Canada. Tubes, structural material and cast iron pipes were also shipped in considerable quantities to the same destinations.

Coal.

Apart from a continued firmness in treble nuts, the coal market is practically featureless. All descriptions of fuel are in need of business, and there is every probability that more pits will be closed down unless some revival in trade takes place very soon. Industrial requirements are far below normal, and export orders are absent. Some collieries are holding out for existing rates, but there is little doubt that anyone with a good order to place can secure more advantageous terms. Aggregate shipments amounted to 219,864 tons, against 278,181 tons in the preceding week and 230,592 tons in the same week of the year 1925.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE conditions in the steam coal trade continue to be very unsatisfactory, and at the moment there appears to be nothing on the horizon to raise hopes of an improvement in the near future. On the contrary, the reverse is the case. Shipments from the Bristol Channel during the week ended the 20th of May were a post-strike record, the figure being nearly 621,000 tons, but it was generally recognised that this quantity could not be maintained, inasmuch as the business was not on the market, neither was there sufficient tonnage to hand to enable such shipments to be effected. Unfortunately, a number of idle tips daily has been the record for the past week or so at local docks, so that it was no surprise to find that for the week ended Friday last there was a reduction in shipments from this Channel of just over 171,000 tons, as compared with the previous week, and it is very questionable whether the figures for this week will show any material improvement inasmuch as tonnage in dock is quite inadequate to the needs of the collieries and business on the market is very dull. A few orders have certainly been placed, such as 100,000 tons for the Central Argentine Railways for delivery from July to December, and the Spanish Navy is reported to have bought 8000 tons of second Admiralty large coals for prompt shipment, while the French Marine is understood to have bought 20,000 tons of Welsh large. The Egyptian Government Public Works contract for 10,000 tons of Welsh coal has been placed with Furness, Withy and Co., Ltd., for delivery at Alexandria, the price being about 34s. per ton c.i.f. All these together do not amount to much when it is realised that the coals are for delivery over a period and that the general demand from abroad is negligible.

French Coal Imports to be Licensed.

As a matter of fact all concerned in the exportation of Welsh coals have had a very depressing week. Following upon the efforts of Spain to restrict imports of foreign coals in order to foster the trade in the native product comes the news that imports of coal to France have to be made under license as from Wednesday of this week (June 1st), although shipments made up to June 5th will not be affected. The French Government signed a Decree on Wednesday of last week, since which time efforts have been made to ascertain exactly what the meaning of it is. The Decree has been issued under the authority conferred upon the Government by Sec. 3 of the Customs Law of 1910, and it is left to the Administrative Departments to apply it. Time alone will show to what extent the operation of the license system will mean a restriction of imports from this country. The position is viewed very seriously in this district, as it has to be borne in mind that shipments of coal and coke from this Channel to France run to between 5 and 6 million tons per annum. One reason given for the action of the French Government is the desire to avoid unemployment in the French coalfields, but there may be more behind it, such as the suspension of large contracts which have been entered into in the past, principally for the supply of German coals. Overproduction is one of the troubles in the coalfields of France, and it is understood that standing stocks of French coal in that country are already round about two million tons. Developments are being closely followed not only by coal-owners and exporters on this side, but also by the members of the French Coal Importers' Association. It is realised that if the adoption of the license system is going to mean a marked reduction of coal imports from this country it will be followed by a restriction in employment at the French ports, so that the national advantage of creating employment in one direction at the expense of another is very questionable.

Miners' Wages.

As foreshadowed, the miners in South Wales are to suffer a reduction in their wages. At a meeting of the South Wales Coal Conciliation Board at Cardiff on Tuesday it was mutually agreed between the owners' and workmen's representatives that the wages rate in the coalfield should be reduced as from June 1st from 42·22 per cent. to 28 per cent. above the 1915 standard base rates, a reduction of 14·22 per cent. The report of the joint auditors showed that the results of the industry for the months of February, March and April would only warrant the payment of a percentage addition to the base rates considerably less than the minimum of 28 per cent. fixed by the 1926 agreement, and therefore the general wage rate automatically fell to this minimum and will operate for the months of June, July and August. Discussion also took place on the question of the subsistence wage. The coalowners had proposed that the subsistence wage should be reduced from 8s. 0½d. per shift to 6s. 10d., but at a meeting of the Executive Council of the South Wales Miners' Federation held at the end of last week, it was decided strongly to resist this reduction and to apply for an increase from 8s. 0½d. to 8s. 7d. When the matter came up before the Coal Conciliation Board on Tuesday there was failure to agree on the question, with the result that the independent chairman (Sir Francis Taylor) is to be called in to give his decision on the point. He has been asked to attend an adjourned meeting of the Board to be held on June 16th.

Tin-plate Trade.

There was an important meeting of tin-plate manufacturers outside the Tin-plate Corporation and Messrs. Baldwins' group at Swansea last week, when 200 mills were represented. It was unanimously decided that a committee should be appointed immediately to formulate a scheme, the principle of which was agreed to, for fixing a minimum selling price for tin-plates in order to avoid unnecessary competition. The purpose is to act in co-operation with the Tin-plate Corporation and Messrs. Baldwins' group. The conditions in the tin-plate industry are by no means satisfactory, and operations have had to be curtailed at some works. The workmen's side of the Joint Industrial Council at its annual meeting on Monday considered the suggested basis of a new sliding scale and the pooling scheme which has been instituted by the manufacturers, but in regard to the latter it was contended that the scheme may operate unfairly as works may be brought to a standstill. It was held that the works should share the available orders either by the curtailment of shifts or the stoppage of works in turn.

Current Business.

The tone of the steam coal market is dull in the extreme, and very little business has been done of late, while the inquiry all round is on very narrow lines. Many collieries have had to work short time. At a number of pits men have received notices to terminate their contracts, while at others disputes have caused an interruption of operations. A notable case is that at the Nos. 1 and 2 Marine Collieries, at Cwm, Ebbw Vale, where a dispute concerning the dismissal of three fanmen has brought about a strike of 1800 to 2000 men. There is a fear that the trouble, unless settled soon, may shortly affect the whole of the Ebbw Vale district. Nominally the market has not altered a great deal, but it is very irregular, and buyers are able to secure concessions on the prices quoted for prompt shipment. Even in the case of smalls the demand is not now so active.

Miners' Holidays.

It has been agreed that the holidays in the coalfield at Whitsuntide shall be Monday, Tuesday and Wednesday of next week. Pitwood workers at the docks will also have the same holidays, but shipment of coal at South Wales ports will be suspended during Monday and Tuesday, work being resumed on Wednesday morning.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Ironworkers' Wages Reduced.

Ironworkers' wages regulated by the sliding scale under the Midland Iron and Steel Wages Board will be reduced 2½ per cent. from Monday next to Saturday, August 6th. This award follows a reduction of 5 per cent. in April, and brings wages to 52½ per cent. above the basis rate of 13s. 6d. per ton.

Black Country Miners' Wages Reduced.

At a meeting of the Joint Board for the mining industry of South Staffordshire and East Worcestershire at Dudley wages for the month were fixed at 52 per cent. on basis rates, representing a reduction of 5 per cent., compared with the figures for May, to take effect as from the first making-up day in the month.

LANCASHIRE.

Furnace Blown Out.

The Barrow Hematite Steel Company, Ltd., has put out of operation one of the three furnaces it had in blast for several months, owing to the quietness in the demand for iron.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE ENGLISH ELECTRIC COMPANY, Ltd., of Queen's House, Kingsway, London, W.C. 2, asks us to announce that it has appointed as its general sales manager Mr. P. N. Rand, who recently relinquished a similar position with the Metropolitan-Vickers Electrical Company.

SIEMENS BROS. AND CO., Ltd., ask us to announce that Dr. H. R. Wright, managing director of that firm, has joined the Board of the British Columbia Telephone and Telegraph Company—a Delaware, U.S.A., Corporation, with its offices in Chicago—in which Siemens Bros. hold an interest.

MESSRS. MARSHALL, SONS AND CO., Ltd., of Britannia Ironworks, Gainsborough, Lincs., inform us that they have appointed Mr. Geo. E. McCaw, M.I.A.E., 112, Bath-street, Glasgow, to represent them in Scotland. Mr. McCaw succeeds the late Mr. J. S. Richardson, who for many years represented the firm.

SPURR, INMAN AND CO., Ltd., of Wakefield, ask us to announce that in consequence of the death of Mr. John Stokes, their managing director, which took place on May 3rd, the following appointments have been made:—Mr. R. D. Sheard, chairman and managing director; Mr. G. H. Hindle, manager; and Mr. F. Burton, secretary.

THE SIEMENS AND GENERAL ELECTRIC RAILWAY SIGNAL COMPANY, Ltd., asks us to announce that on June 1st its head office was removed from 21, Great Queen-street, Kingsway, London, W.C. 2, to Central House, Kingsway, London, W.C. 2. Telephone: Regent 7050. Its registered office will be situated as heretofore at Caxton House, Westminster.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 4 0	
No. 1 Foundry	4 7 6	—
No. 3 Foundry	4 2 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 19 0	3 19 0
No. 1	3 19 6	3 19 6
Cleveland—		
No. 1	3 12 6	3 12 6
Silicious Iron	3 12 6	3 12 6
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 8 6
Mottled	3 8 0	3 8 0
White	3 8 0	3 8 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 12 6	—
,, ,, Foundry	4 1 6	—
(3) Northampton—		
Foundry No. 3	3 7 6 to 3 10 0	
Foundry Forge	3 6 0	—
(3) Derbyshire—		
No. 3 Foundry	3 12 6	—
Forge	3 10 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	3 12 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 13 6 (a), 4 16 6 (b), 5 0 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 15 0	10 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	12 5 0	—
Common Bars	11 5 0	—
Best Bars	12 5 0	—
LANCS.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 15 0 to 11 0 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	12 10 0 to 12 15 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ¾in. and up	8 2 6 to 8 5 0, £8 0 0 to 8 2 6	
Sections	7 12 6 to 7 15 0, £7 10 0 to 7 12 6	
Steel Sheets, under 3/16 in. to ¼in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 0 0 to 16 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0	
MANCHESTER—		
Bars (Round)	8 15 0	—
,, (Small Round)	8 2 6	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
,, (Lancs. Boiler)	11 5 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 5 0 to 7 10 0	
Hoops	12 0 0	—
Soft Wire Rods	9 5 0	—
MIDLANDS—		
Small Rolled Bars	8 0 0 to 8 10 0	
Billets and Sheet Bars	6 15 0 to 7 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 12 6 to 14 15 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/3 to 19/6
Block Tin (cash)	291 10 0
,, (three months)	284 12 6
Copper (cash)	54 7 6
,, (three months)	55 0 0
Spanish Lead (cash)	24 6 3
,, (three months)	24 13 9
Spelter (cash)	28 7 6
,, (three months)	28 7 6
MANCHESTER—	
Copper, Best Selected Ingots	59 10 0
,, Electrolytic	60 5 0
,, Strong Sheets	86 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 0 11½
,, Condenser lb.	0 1 1½
Lead, English	26 2 6
,, Foreign	25 0 0
Spelter	28 12 6
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 15 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, ,,Max. 2 p.c. carbon	£36 5 0	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	15/-
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£12 10 0 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 5 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 5 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/-
,, ,, Ell	14/3
,, ,, Splint	15/6 to 16/6
,, ,, Trebles	14/6
,, ,, Doubles	13/- to 13/6
,, ,, Singles	13/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/9
,, ,, Jewel	15/6
,, ,, Trebles	14/3
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 13/9
Screened Navigation	18/- to 19/-
Trebles	14/9
Doubles	13/3 to 13/6
Singles	13/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/9
Secondary Steam	13/-
Trebles	14/9
Doubles	13/3 to 13/6
Singles	13/-

ENGLAND.

(8) N.W. COAST—	
Steams	27/6
Household	42/6 to 58/6
Coke	27/6
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	13/9
Steam Smalls	10/6
Unscreened	13/6 to 13/9
Household	21/- to 27/-
DURHAM—	
Best Gas	16/6 to 17/-
Second	14/3 to 14/9
Household	21/- to 27/-
Foundry Coke	23/6 to 26/6

SHEFFIELD—	Inland.	
Best Hand-picked Branch	29/- to 30/-	
Best Selected House Coal	24/- to 26/6	—
Screened House Coal	20/- to 22/-	—
,, ,, Nuts	18/- to 20/-	—
Yorkshire Hards	17/6 to 19/6	—
Derbyshire Hards	17/6 to 19/6	—
Rough Slacks	10/6 to 11/6	—
Nutty Slacks	8/- to 9/-	—
Smalls	3/- to 5/6	—
Blast-furnace Coke (Inland)	22/- to 27/6 at ovens.*	
,, ,, (Export)	f.o.b.	19/- to 19/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	22/- to 22/6
Second ,, ,,	20/6 to 21/6
Best Dry Large	20/- to 21/-
Ordinary Dry Large	19/- to 19/6
Best Black Vein Large	20/6 to 21/-
Western Valley Large	19/- to 19/6
Best Eastern Valley Large	18/6 to 19/-
Ordinary ,, ,,	18/- to 18/6
Best Steam Smalls	14/- to 14/6
Ordinary Smalls	12/- to 14/-
Washed Nuts	18/- to 21/6
No. 3 Rhondda Large	22/- to 23/-
,, ,, Smalls	16/- to 17/-
No. 2 ,, Large	19/- to 19/6
,, ,, Through	17/6 to 18/-
,, ,, Smalls	13/- to 14/-
Foundry Coke (export)	40/- to 45/-
Furnace Coke (export)	30/- to 32/6
Patent Fuel	25/- to 26/-
Pitwood (ex ship)	30/6 to 31/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	41/- to 45/-
Seconds	30/- to 37/-
Red Vein	25/- to 30/-
Machine-made Cobbles	45/- to 50/-
Nuts	45/- to 47/6
Beans	32/6 to 35/-
Peas	20/- to 22/-
Breaker Duff	9/- to 9/6
Rubbly Culm	11/- to 11/9
Steam Coals:	
Large	21/- to 22/-
Seconds	19/- to 21/-
Smalls	11/- to 12/-
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 22/- per ton at ovens.

French Engineering Notes.

(From our Correspondent in Paris.)

British Coal Trade Imperilled.

It cannot be too strongly emphasised that the miners' strike in Great Britain last year created a new situation on the Continent which is having the effect of permanently restricting the consumption of British coal. On account of that strike, the continental fuel production had to be increased to cover the deficit caused by the suspension of British exports, and the French collieries have so largely augmented their output as to suggest the idea that, with the aid of economies in fuel consumption, they may be able eventually to supply practically the whole of the home needs. Therefore the French colliery industry is to be encouraged and protected, principally against the competition of British coal, which is placing the home collieries in a very serious predicament. An official statement this week announces that the Government has decided to prohibit the importation of coal, except by licence, which will be accorded by the Ministry of Finance after approval by the Minister of Public Works. That means that, henceforth, an importer will not be able to introduce a ton of coal into the country without a licence, which will only be granted in the event of particular reasons being adduced to justify the importation. Any application will probably be refused if it be found that the needs can be supplied by French coal. In explaining the reasons for this restriction of fuel imports, the Government states that the primary cause of the present difficulty was the miners' strike in Great Britain last year and the alleged "dumping" that has taken place since then, whereby the monthly imports exceed the country's requirements by 600,000 tons. As the French collieries are unable to dispose of their coal, stocks are accumulating, and at present there are more than 2,000,000 tons of coal at the pits. The Government declares that it intends to do everything in its power to prevent unemployment and a further reduction in wages. It has already decided that French coal must be used in all Government services, and that the obligation to employ French coal will be stipulated wherever possible in State contracts, while special railway rates and shipping freights will be applied to French coal for certain destinations. Contracts for the Navy have recently been given out to French coalowners. The Government also states that it intends to increase the import duties on coal on condition that the home coalowners undertake to reduce their selling prices to a corresponding extent, so that consumers will not suffer from the higher duties. This restriction, which may become at any moment a qualified prohibition, is causing great uneasiness to importers and consumers. Apart from the fact that there will be a considerable diminution of traffic at some of the ports, it is not easy to see what will happen in the case of existing contracts, unless licences are granted to permit of their being executed. Industrial consumers are alarmed at the prospect of paying much higher prices for coal, for while the Government will probably be able to exercise a certain control over prices by threatening to admit foreign coal, as it does in the case of some commodities, it is certain that consumers will have to pay in order to keep the miners, the majority of whom are foreigners, employed. There is an antagonism between the mining and manufacturing interests, and manufacturers naturally do not see why their interests should be sacrificed for the benefit of the coalowners. The restriction of coal imports is a very serious matter for the British colliery industry, but whether it will be wholly effective or not will depend upon the quality of the French coal, which is not suitable for all purposes.

Paris Water Supply.

After a long debate upon the alternative schemes of providing Paris with water by constructing barrage reservoirs on the upper reaches of the Seine, and by pumping subterranean water from the Vals do Loire, it was finally decided to adopt the latter proposal, although there is a prevailing idea that it will be extremely difficult to carry out either of those schemes. Local opposition is far too strong to be readily overcome, and it is even averred that, for reasons of national defence, the Government would hesitate to authorise works which left Paris dependent upon sources of supply at such considerable distances away. At the same time, the whole question of the Paris water supply is subjected to the influence of conflicting interests, for each scheme has its ardent supporters. Little is now heard of the "verdunisation" process of Monsieur Philippe Bunau-Varilla, although it continues to be used in a number of towns, but more prominence is given to the ozone process of water sterilisation on the ground that, with the present cost of electricity, the treatment is not expensive, and it is argued that consumers would readily pay a little more for water that is perfectly sterilised without the use of chemicals. In any case, the Paris Municipal Council no longer relies entirely either upon the barrage reservoirs or upon the Vals de Loire, for it has decided to carry out other works around Paris, including an extension of the Saint-Maur works, which operated continuously before the war sterilising Marne water by electricity, but has since been working intermittently. A sum of 10,000,000f. has been voted to increase the capacity of the Saint-Maur works from 100,000 cubic metres a day to 250,000 cubic metres. Works are also to be erected at Orly.

Sewage Disposal.

The proposal to lay out new sewage farms in the neighbourhood of Paris is meeting with so much local opposition as to cause serious embarrassment to the Paris Municipal Council. During the summer the quantity of sewage and used water that must be disposed of reaches at times a million cubic metres a day. The decanting and other works are capable of dealing with 800,000 cubic metres, and it is hoped that the experiments being carried out with the bacterial treatment of sewage at Port Marly and Colombes will allow eventually of the remainder being dealt with satisfactorily. Meanwhile, about 200,000 cubic metres a day must be sent to sewage farms, and the proposal to lay out additional farms in the picturesque valley of the Seine has aroused much local opposition.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

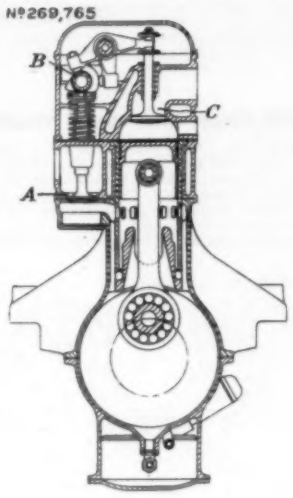
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

269,765. January 25th, 1927.—VALVE MECHANISM FOR TWO-STROKE ENGINES, J. H. Booth, 18, Tudor-gardens, Barnes, London, S.W. 13; F. A. Sidwell, 10, Barston-road, London, S.E. 27; W. P. Smyth, 10, Barston-road; and T. M. Booth, 129, Grosvenor-street, Derby.

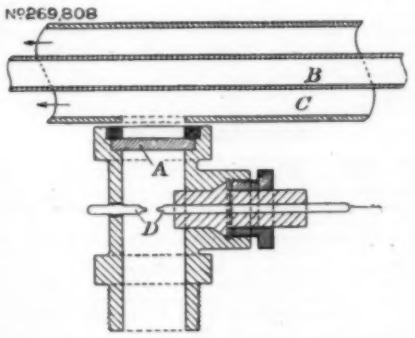
In this two-stroke engine both the admission and exhaust are



controlled by mechanically operated valves. The drawing is so explicit that the invention needs little description. A is the inlet valve, worked directly by the cam shaft B, while C is the exhaust valve, which is operated from the same cam shaft through a rocking lever. An alternative arrangement with the cam shaft above the exhaust valve is illustrated.—*April 28th*, 1927.

269,808. November 9th, 1926.—THE USE OF ULTRA-VIOLET RAYS FOR SUPPORTING COMBUSTION, *H. A. Gill*, 51, *Chancery-lane, London, W.C.* 2.

The inventors employ a modified form of sparking plug, which is closed at the top by a quartz window A. Above this window there is arranged an ultra-violet ray apparatus B, which incidentally produces ozone in the surrounding tube C.

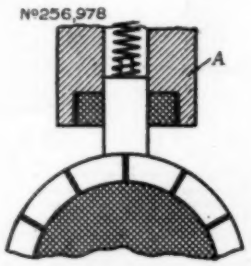


This ozone is conducted to the carburetter. The rays penetrating the quartz window ionise the space surrounding the sparking points D D, which, it is said, may consequently be spaced apart as far as 3 mm. or more, when employing normal voltages. The scheme is claimed to increase the rate of combustion of the explosive charge.—*April 28th*, 1927.

DYNAMOS AND MOTORS.

256,978. August 12th, 1926.—MEANS FOR PREVENTING THE BURNING OF COMMUTATORS AND SLIP RINGS OF DYNAMO-ELECTRIC MACHINES DUE TO EXCESSIVE WEAR ON THE BRUSHES, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemensstadt, Germany.

The object set forth in the title to this specification is achieved

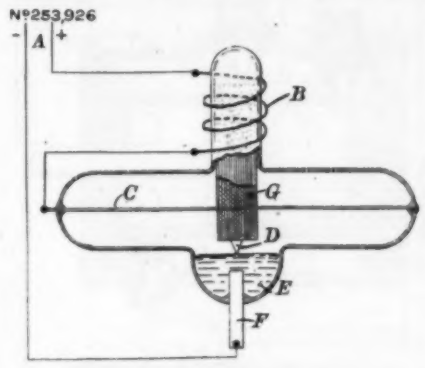


by lining the bottom part of the brush guide box A with insulating material, and as wear takes place on the brush it is pushed forward by the spiral spring. The brush gradually leaves the conducting guide box A and finally enters the insulating body and when its upper edge breaks contact with the metal guide box the current is cut off and burning at the commutator is therefore prevented.—*April 28th*, 1927.

SWITCHGEAR.

253,926. June 17th, 1926.—IMPROVEMENTS IN OR RELATING TO ELECTRIC CURRENT SWITCHES, Jacques Brettmon, of 226, Rue de Rivoli, Paris, France.

This specification describes an electrical device for making and breaking a circuit very rapidly and which possesses little inertia. It may be employed instead of a trembler make-and-break device for the purpose of obtaining high-tension currents

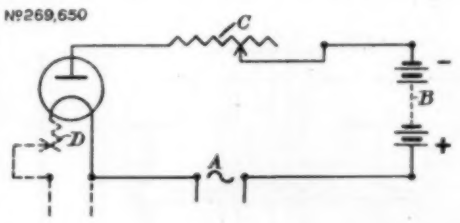


or high-frequency currents. Referring to the diagram, when the circuit A is completed current passes through the coil B to the tungsten wire C and through the point D to the pool of mercury E and returns by way of the conductor F. The soft iron core G is then raised by the coil B and the circuit is broken between E and D. The iron core G then falls again under the action of gravity and the circuit is again established. Apparently the wire C passes through a slot in the iron core G.—*April 28th*, 1927.

BATTERIES AND ACCUMULATORS.

269,650. January 19th, 1926.—IMPROVEMENTS RELATING TO THE CHARGING OF ELECTRIC BATTERIES OR ACCUMULATORS, Charles Gonville Banister and the Chloride Electrical Storage Company, Ltd., both of Clifton Junction, near Manchester.

Accumulators are charged in accordance with this invention by connecting them in series with a thermionic rectifying valve, or a number of these valves in parallel, without the use of choking coils or similar arrangements in the anode circuit. A is the

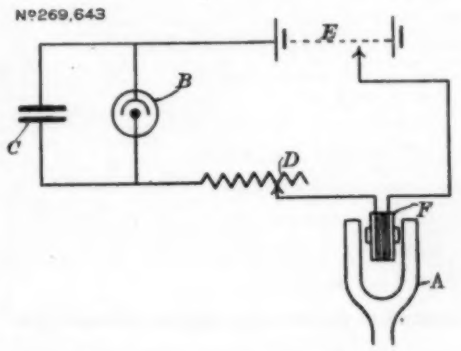


alternating-current supply, B the battery being charged, and C a resistance in series with the battery. A separate source of current which may be either direct or alternating current is used for heating the filament, and the load on the valve and the rate of charging the battery can be controlled by adjusting the temperature of the cathode by varying the resistance D, or by altering the value of the resistance C. Another scheme for changing high and low-tension accumulators simultaneously is also described.—*April 19th*, 1927.

TELEGRAPHS AND TELEPHONES.

269,643. January 18th, 1926.—IMPROVEMENTS IN METHODS OF GENERATING ELECTRICAL AND MECHANICAL OSCILLATIONS, William Henry Eccles, of 13, Catherine-street, Westminster; and Winifred Agnes Loyshon, of 8, Hunter-street, London, W.C. 1.

This specification describes a method of generating alternating or fluctuating currents and voltages of constant period with the aid of the regular vibration or other motion of a body, sustained in motion directly or indirectly by the generated currents. One of the methods of carrying out the invention is shown in the accompanying diagram, where A is a tuning fork that is



caused to vibrate, B a neon tube, C a condenser, D a variable resistance, E a battery from which any desired voltage may be taken, and F an electro-magnet. In the apparatus that has been constructed it was found convenient to use a resistance that could be varied up to a maximum value of 100,000 ohms and a battery that could give a maximum pressure up to 200 volts, and these voltages and resistance values were found to be suitable for any tuning fork having a frequency between 300

and 2000 vibrations, when a neon tube capable of passing about one-half of a milliampère was employed. There are three other illustrations.—*April 19th*, 1927.

PUMPING AND BLOWING MACHINERY.

269,818. December 24th, 1926.—COMPRESSOR UNLOADING DEVICES, The Ingersoll-Rand Company, 15, Exchange-place, Jersey City, New Jersey.

By means of this arrangement an air compressor can be unloaded in four stages of one-quarter load each. The first stage is effected by opening the valve A so that the clearance

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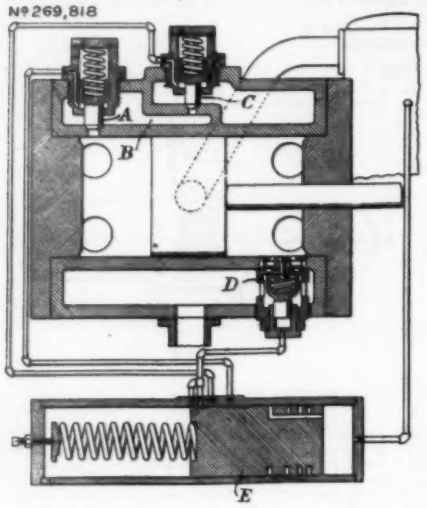

space B is in communication with the cylinder. For the second stage the valve C is opened and further clearance space is provided. At the third stage C is closed, A is kept open, and the inlet valve D is held off its seat. Finally, to unload the machine completely, the valve C is opened again. The several manœuvres are controlled by the spring-loaded piston E, which is subject to the receiver pressure.—*April 28th*, 1927.

LIGHTING AND HEATING.

269,790. October 4th, 1926.—AIR FILTERS, The Visco Engineering Company, Ltd., and F. C. Smith, 162, Grosvenor-road, London, S.W. 1.

This air filter is of the type in which the air or other gas is drawn through perforated plates kept continuously moist by

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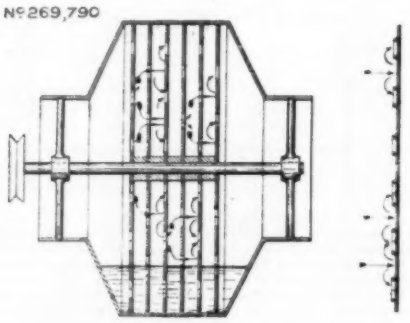

being rotated over a trough of water, into which they dip. The claim in the specification is for the form of the perforations, which have upturned edges. This form is said to trap solid matter in the air or water effectively, while it allows free passage for the air.—*April 28th*, 1927.

269,828. February 9th, 1927.—IMPROVEMENTS IN THE MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS, *The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2.*

The crystallisation of the filament in electric incandescent lamps is now carried out in such a manner that long or stable crystals are formed, and to assist this process the wire is cleaned superficially before it is placed in the bulb and thus freed from the carbon which has adhered to it during the drawing process. It has been observed that in such lamps, in which the filament has been cleaned beforehand, the Edison effect, which should set in on ageing, and which is most necessary for the final evacuation or "clean up," either does not occur at all or occurs only very feebly, and in any case it cannot be caused completely to vanish by ageing. As a result, in the finished lamps a slight blue glow always accompanies the subsequent normal burning and the lamps show greater liability to blackening and short circuiting or "flashing." To overcome this difficulty an electron emitting material is mixed with the substance ("the getter") that is introduced into the bulb for the purpose of removing residual gases and preventing blackening. As is known, earth metal oxides, particularly thorium oxide, are good electron emitting materials. Preferably, colloidal thorium oxide is mixed with a suspension of a getter, and the suspension is then sprayed on to the filament supports in the known manner. In electric incandescent lamps into which such a material is introduced the Edison effect sets in so strongly that the final evacuation or "clean up" proceeds very rapidly. With the disappearance of the residual gases the blue glow stops suddenly and does not appear again, the vacuum having become very high.—*April 28th*, 1927.

MACHINE TOOLS AND SHOP APPLIANCES.

269,330. April 19th, 1926.—WIRE-DRAWING DIES, A. Simons, 408, Concord-avenue, New York.

In setting out the nature of his invention in the specification the inventor remarks: "I have discovered that the reason why it has been difficult efficiently to use a lubricant in drawing thick wire is largely due to the fact that practical manufacturing considerations have made it necessary to make the curvature of the drawing surface of a die increase in proportion to the internal diameter of the die. That is, the large dies used for drawing heavy wire have always been made with an internal drawing surface of a relatively large curvature, and it has been impractical to manufacture them save with such relatively large curvature. According to my invention, the true drawing surface of the die is associated with an adjacent surface of such contour and dimensions that, while the latter is

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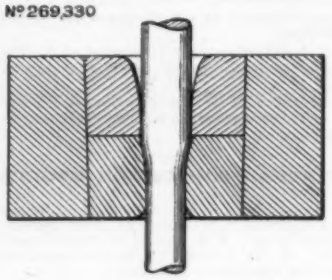

closely approximated to the periphery of the wire on its approach to the die, it yet enables a certain quantity of lubricant to be drawn through it on the surface of the wire, whereby I have found that lubricant more readily passes through the die itself than is the case if this adjunct is omitted." The drawing needs no comment.—*April 21st*, 1927.

MOTOR CARS AND ROAD TRAFFIC.

269,313. March 26th, 1926.—IMPROVEMENTS IN AND RELATING TO MAGNETO IGNITION SYSTEMS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Arthur Primrose Young, of Borrowell, Borrowell-lane, Kenilworth, and Ernest George Parrott, of Prescott House, Kenilworth.

A magneto A having an automatic timing device B on its

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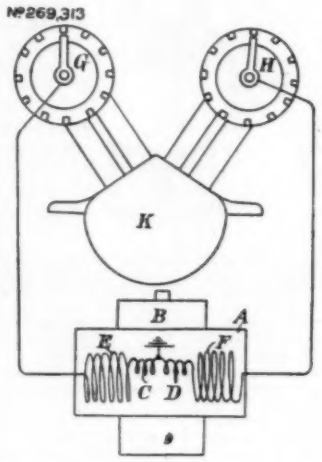

driving shaft is provided with two primary windings C and D, and corresponding secondary windings E and F. The ends of the latter windings are brought out by the leads to separate distributors G and H respectively, mounted on cam shafts driven by the engine K. Whilst reference is made only to two-point ignition systems, the scheme may be applied to multi-point ignition systems wherein there are three or more ignition plugs per cylinder.—*April 21st*, 1927.

MISCELLANEOUS.

264,540. January 18th, 1927.—IMPROVEMENTS IN OR RELATING TO RODS OR TUBES OF INSULATING MATERIAL, MORE PARTICULARLY FOR SUSPENSION OR STRAIN INSULATORS, *International General Electric Company, Incorporated, of 120, Broadway, New York.*

The insulating material described in this specification is in the form of rods or tubes, and it is said to have great dielectric and mechanical strength. In the case shown in Fig. 1, the insulating material A consists of long fibres, which are superposed and compressed together with the addition of an adhesive, such as natural or artificial resin. The end of the tube so formed is

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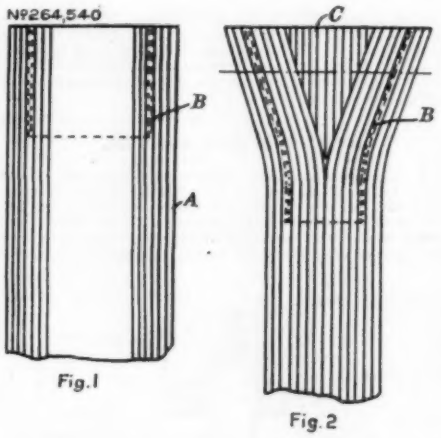

Fig. 1 Fig. 2

provided with a metal insertion B, which is inserted between the layers of fibrous material, and it is completely embedded in the insulating material by means of the adhesive. In the case of Fig. 2, one end of the insulator is widened by the insertion of a wedge C, and the widened portion is also provided with a metal insertion B. Insulating material constructed in accordance with the invention may be used as a core for suspension and straining insulators, and the durability of the ends of the core is said to be considerably increased by the metal insertions C. The metal insertions may be made of perforated metal strip.—*April 21st*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ROYAL INSTITUTION, 21, Albemarle-street, W. 1. Discourse, "Carlyle as an Historian," by Mr. George M. Trevelyan. 9 p.m.

PHYSICAL SOCIETY.—Imperial College of Science. Lecture and discussion on the forthcoming eclipse of the sun. 5 p.m.

SATURDAY, JUNE 4TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Eastern District meeting at Maidstone.

THURSDAY, JUNE 9TH.

THE OPTICAL SOCIETY.—At the Imperial College of Science, Imperial Institute-road, South Kensington. Papers: "The Use of Photo-electric Cells for Precision Photometry of Electric Lamps," by Mr. T. H. Harrison; "An Experimental Study of the Best Minimum Wave Length for Visual Achromatism," by Mr. R. Kingslake; "On Brewster's Bands," Part II., by Mr. Sushil Krishna Datta. 7.30 p.m.

FRIDAY, JUNE 10TH.

HEAT ENGINE TRIALS COMMITTEE.—At the Institution of Civil Engineers, Great George-street, S.W. 1. Report of the Special Committee on Tabulating the Results of Heat Engine Trials will be submitted for discussion. 6 p.m.

ROYAL INSTITUTION.—21, Albemarle-street, W. 1. Discourse, "The Excavations at Ur," by Mr. C. Leonard Woolley. 9 p.m.

SATURDAY, JUNE 11TH.

THE INSTITUTION OF CIVIL ENGINEERS.—Birmingham and District Association. Visit to London, Midland and Scottish Railway Works at Barnt Green. Members will assemble at Barnt Green Station at 10.49 a.m.

TUESDAY, JUNE 14TH.

UNIVERSITY COLLEGE, GOWER-STREET, LONDON, W.C. 1.—In connection with the centenary celebrations of the College, Professor J. A. Fleming, F.R.S., will deliver an address, entitled "A Hundred Years of Electrical Engineering." 8.30 p.m.

TUESDAY, JUNE 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Visit to the Kent Cement Works at Greenhithe by steamer, which will start from Westminster Bridge Pier at 10 a.m.

CONTRACTS.

WM. BEARDMORE AND CO., Ltd., of London and Glasgow, have received an order from the London, Midland and Scottish Railway for twenty-five 0–6–0 locomotives.

WILLIAM BOBY AND CO., Ltd., of Brookfield House, London, W. 1, have received an order for one of their gravity filtration plants for an Indian Native State. The plant will have an initial capacity of 3½ million gallons of water per day.

THE GREAT WESTERN RAILWAY COMPANY officially announces that the following contracts have been placed:—(*a*) Overhaul of steamship St. Julien—Cammell Laird and Co., Ltd., Birkenhead; (*b*) repairs to Eastern Breakwater, Swansea—Mr. George Palmer, Neath; (*c*) repairs to oil bunker Jetty, King's Dock entrance, Swansea—William Muirhead, Macdonald, Wilson and Col, Ltd., 41, Parliament-street, S.W. 1.; (*d*) supply of two three-ton electric luggage lifts for Temple Meads Goods Station, Bristol—William Wadsworth and Sons, Ltd., High-street, Bolton; and (*e*) rebuilding portions of a boundary wall between Gogarth Halt and No. 3 Tunnel, Aberdovey—Mr. Hugh Lewis, 4, Cliff Side, Aberdovey.

CONGRESS ON THE EXPLOSION ENGINE.—A Congress on the Explosion Engine is to be held on the 16th and 17th inst., under the auspices of the Comitato Nazionale per le Onoranze ad Enrico Bernardi. The Congress is to be held in the Royal School of Engineering, which is attached to the University of Padua, in which city Professor Bernardi, whose investigations contributed so much to the development of the explosion engine, was born. It has the support of the Ministers of National Economy and of Education. At the International Sample Fair, which is being held at Padua from the 5th to the 20th inst., there are to be two exhibits, one dealing with the methods of Bernardi and with relics of that distinguished scientist, and the other with the latest types of explosion engines used in motor vehicles and aeroplanes. It is proposed that this Congress shall be the first of a series, and that the communications received at each shall be collected and issued in volume form.

PAST AND PRESENT CREWE PUPILS' 37TH ANNUAL DINNER.—The 37th annual dinner of Past and Present Crewe Pupils and Premiums was held this year at the Crewe Arms Hotel, Crewe, on Friday, May 27th, the chairman of the gathering being Captain H. P. M. Beames, mechanical engineer at Crewe for the London, Midland and Scottish Railway Company. Altogether ninety-eight past and present Crewe men attended, together with a large number of distinguished visitors, amongst whom were the guest of the evening, Sir Herbert Walker, K.C.B., General Manager of the Southern Railway; Lord Congleton; Monsieur Lacoin, Chief Mechanical Engineer of the Orleans Railway; Mr. R. E. L. Maunsell, Chief Mechanical Engineer of the Southern Railway, and Sir Henry Fowler, the President of the Institution of Mechanical Engineers and Chief Mechanical Engineer of the London, Midland and Scottish Railway. Of the many past Crewe men present may be mentioned Sir John A. F. Aspinall; Mr. H. N. Gresley, Chief Mechanical Engineer, L. and N.E. Railway; Mr. H. Armistead, Bombay, Baroda and Central India Railway, and Mr. W. A. Cardew, N.G.S. Railway, India. Earlier in the day a large party made an inspection of the Crewe works and was afterwards entertained to tea by Mrs. Hewitt Beames. This is the first occasion on which this reunion has taken place at Crewe, although the dinners have been held for close on forty years; but it was thought by the Committee for the dinner that many past Crew men would like to have an opportunity of again seeing over the Crewe works, which have been so much modernised of late, and, furthermore, it thought it would be a good plan to have the gathering in the old town, in view of the fact that it is the jubilee of the Borough of Crewe. The banquet itself proved to be one of the most successful in the long history of these dinners.